

UNIVERSITÉ DE GENÈVE
INSTITUT UNIVERSITAIRE DE HAUTES ETUDES INTERNATIONALES

A REACTION FUNCTION APPROACH
TO MACROECONOMIC POLICY
WITH AN
APPLICATION TO GERMANY, 1960-73

THÈSE

présentée à l'Université de Genève
pour l'obtention du grade de Docteur ès Sciences Politiques

par

Takahiko MUTOH
(JAPON)

1979

THÈSE N° 315

Imprimerie Shinkodo (Tokyo)

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La Commission mixte, composée des Doyens des Facultés de droit, des lettres, et des sciences économiques et sociales, et du Directeur de l'Institut universitaire de hautes études internationales, sur le préavis de M. Jacques L'HUILLIER, Professeur à l'Université et à l'Institut, de M. Alexandre SWOBODA, Professeur à l'Institut de M. Hans GENBERG, chargé de cours à l'Institut, et de M. Clifford WYMER, Senior economist, International Monetary Fund (Washington), autorise l'impression de la présente thèse sans entendre Par là exprimer d'opinion sur les propositions qui y sont énoncées.

Genève, le 6 août 1979

Pour la Commission mixte:

Christian Dominice

Directeur de l'Institut universitaire

Thèse No 315



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TAKAHIKO MUTOH

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FOREWORD

This thesis attempts to develop a method for making quantitative appraisals of the formation of macroeconomic policy. A critical feature of the model is that it treats the behavior of policy making authorities and the private sector endogenously. The long theoretical tradition of treating policy instruments exogenously should not make us forget the fact that the behavior of policy authorities is undoubtedly affected by movements in some target variables such as national income, foreign reserves and so on. Although the assumption that policy variables are exogenous can be justified at the theoretical level, it is less convincing at the empirical level where the simultaneous determination of the behavior of both the private and public sector must be taken into account.

The literature evaluating the effectiveness of macroeconomic policy uses basically two approaches. One attempts to estimate the economic structure of the private sector, treating policy variables as exogenous. The other, which is often referred to as the "reaction function approach", identifies the set of policy variables as endogenous while the private sector is exogenous.

Once the importance of the interdependence between authorities and the private sector is recognized, it must be accepted that both approaches may involve serious

specification errors which can only be corrected by treating both sectors endogenously. Therefore, the model presented here treats both policy and private sector variables endogenously and considers explicitly the dynamic interactions between them.

A prototype of such a specification is the policy mix theory developed by Mundell proposing the following reaction function :¹⁾

$$DP = f(P)$$

where P is a vector of policy variables, D is the differential operator and f denotes an appropriate function. f may in fact be interpreted as an amalgamation of (1) the private sector's responses to the authorities' behavior; (2) the authorities' responses to the private sector, and (3) the private sector's behavioral parameters such as propensity to save, interest elasticity of investment demand and so on. An obvious empirical extension of this approach would be the construction of a model to separate these factors and consider their dynamic properties.

In line with the argument presented above, Chapter 1 will survey the existing literature on the analysis of reaction functions. It will be shown that there are basically two different but interrelated approaches to this analysis. Some critical comments on these approaches will be made, followed by a description of the alternative method which will be pursued in this paper.

Chapter 2 will be devoted to a somewhat different subject: a comparison between the equilibrium and disequilibrium approaches to economic analysis. The reason for this digression is that, since later chapters will contain some dynamic adjustment hypotheses, it is

1) Mundell, Robert A., International Economics (The Macmillan Company, New York, 1968), Ch. 14.

necessary to establish the kind of relationships for which these hypotheses can be introduced.

Chapter 3 will discuss the broad outline of the model. It will be shown that this model derives basically from the Mundellian policy mix model in a simultaneous equation framework. Issues related to the policy mix argument, such as the problem of costs in changing authorities' reactions to targets, will be discussed.

Chapter 4, in preparation for the following chapter, discusses macroeconomic policy formation in Germany between 1960 and 1973. The discussion will focus especially on the policy tools used by authorities during that period.

Chapter 5 uses the approach developed in the former chapters in analyzing German macroeconomic policy. A relatively simple macroeconomic model will be specified and estimated simultaneously with the authorities' reaction functions. The basic results will be shown to be consistent with the Mundellian policy mix prescription.

Chapter 1

A SURVEY OF THE ANALYSIS OF REACTION FUNCTION

The purpose of this chapter is to review critically the existing literature on authorities' policy reaction functions. Two different but related approaches to the study of reaction functions are distinguished: one is termed the RDJ approach (after Reuber-Dewald-Johnson)¹⁾ the other is the Theil approach.²⁾ The first section deals with the RDJ approach which opened the way for the study of government behavior. The second deals with Theil's criticism of this approach, together with an appraisal of his own approach.

1) Reuber, Grant L., "The Objectives of Canadian Monetary Policy, 1949-61: Empirical Trade-offs and the Reaction Function of the Authorities", Journal of Political Economy (Apr. 1964), pp. 109 - 132, Dewald, William and Johnson, Harry G., "An Objective Analysis of the Objectives of American Monetary Policy, 1952-61", in Deane Carson (ed.), Banking and Monetary Studies (Homewood, Ill., Richard D. Irwing, 1963) pp. 171 - 189.

2) Theil, Henri, Optimal Decision Rule for Government and Industry (Amsterdam, North Holland, 1964)

1. RDJ Approach

(a) The original formulation

In their pioneering paper published in 1963¹⁾ Dewald and Johnson state the purpose of their study:

"...criticisms (on government policy) have been typically based on observations of the economy and the assertion of private value judgments... The defense, for its part, has rested on literary arguments concerned with justifying actual policy actions by reference to the general objectives of policy or with defining objectives in terms consistent with the policy. Out of such an ill-defined and semantically slippery debate, little can be expected to emerge in the way of positive knowledge about...the objectives of economic policy...."

It was not by accident that such a critical comment was made to apply not only to policy authorities but also to the critics of those authorities. By an accord between the Federal Reserve and the U.S. Treasury in early 1951, the scope of monetary policy was enlarged to the extent that the FED was relieved of its responsibility for maintaining the price of public debts. A more active use of monetary policy became possible, and the necessity to use the policy in controlling the macro-behavior of the economy became widely recognized. Under such circumstances, the poor performance of the American

1) Although pioneering in the field of the study of reaction functions, the Dewald-Johnson paper was not the first one that applied the concept of the reaction function. As they note (Dewald-Johnson op. cit., p. 173, fn. 2), the concept was invented by Reuber. Reuber's study was however not published until 1964 (see Reuber op. cit.).

economy at the end of the 1950's gave rise to much criticism of the government's monetary policy which, according to the critics, attached too much importance to the target of preventing inflation. The necessity for an objective standard for appraising the effectiveness of monetary policy became apparent; hence the comment by Dewald and Johnson quoted above.

Reflecting the circumstances from which the study of reaction functions emerged, much of the literature was first concerned with estimating objectively how the actual behavior of the policy authorities is determined. Specifically, a set of "target" variables were chosen as explaining the government's behavior. Thus, monetary policy was explained by the level of income, the balance of payments development, the price level and so on. In their estimate of the monetary policy function, Dewald and Johnson used the following specification:

$$M_t - M_{t-1} = (\beta_1 U_t + \beta_2 Y_t + \beta_3 p_t + \beta_4 B_t - M_{t-1})$$

(1-1)

where U is the percentage unemployment rate, Y the real gross national product, p the consumer price index, and B the balance of payments deficits. It is assumed that the authorities' desired level of the money stock at time t is a function of the level of unemployment, income, price level and the balance of payments. It is also assumed that the desired level cannot be attained instantaneously because of adjustment costs, time lags and so on. Therefore, the change in the money supply during the current period ($M_t - M_{t-1}$) is only a fraction of the desired change (the bracketed term of equation (1-1)). Using U.S. quaterly data for the period 1952/1 to 1961/4, Dewald and Johnson obtained the following result:

$$\begin{aligned}
 M_t = & 26.88 + .75 M_{t-1} + .46 U_t + .038 Y_t - \\
 & \quad (.07) \quad (.14) \quad (.015) \\
 & - .088 p_t + .00036 B_t \quad R^2 = .99 \quad (1-2) \\
 & \quad (.055) \quad (.00020)
 \end{aligned}$$

then equating $M_t = M_{t-1}$, they obtained the following empirical reaction function:

$$M = 109.20 + 1.86 U + .053 Y - .36p + .0015 B \quad (1-3)$$

The estimated reaction coefficient on the balance of payments deficits had an unexpected sign (positive), but the significance level of this coefficient was very low. Further, the estimate of the reaction coefficient on the price level had the expected (negative) sign, but again with a relatively low significance level in comparison to the coefficients of the unemployment rate and the income level. From these estimates Dewald and Johnson concluded that American monetary policy during the sample period mainly emphasized unemployment and growth (income) targets.

(b) Shortcomings of the RDJ approach

Like many other pioneering studies, the Dewald-Johnson article has some weaknesses.

First, it might be argued that they wrongly assume the reaction coefficients to be stable during the sample period. Since, as will be shown later, the estimated reaction coefficients may be interpreted (although not by necessity) as composed of (a) the weight attached by the authorities to each target and (b) the effect of the policy upon the target, the reaction coefficient may well be changing if (a) and/or (b) is changing during the sample period. Christian emphasized this point¹⁾ and showed

1) Christian, James W., "A Further (to the next page)

that the estimated reaction coefficients, reflecting presumably the changes in weights attached to each target, change substantially, depending on which sample period is used for estimation. He showed, for instance, that the reaction coefficient on the balance of payments, not significantly different from zero in the Dewald-Johnson article, becomes significant if the sample period is limited to the latter half of that used by DJ. This indicates that the balance of payments problem increased in importance as a policy target in the late 1950's and the early 1960's.

The second problem with the DJ paper is its choice of policy variables. Here they use the conventional definition of the money supply (currency plus demand deposits). The underlying assumption, needless to say, is that the money supply can be fully controlled by the authorities. In order for this assumption to be valid, two conditions must be met. First, the money multiplier should somehow be controllable by the authorities, because what they can control strictly is not the money supply itself, but the supply of the high-powered money. Secondly, the effect of the balance of payments on the domestic money supply should be negligible. (This latter point however can be neglected as long as the key currency country like the US is concerned.)

These considerations imply the following: First, one has to check whether the assumption of the controllable money multiplier is justified. Secondly, it is necessary to choose a policy variable that is not directly effected by balance of payments development but by the reaction of the authorities.²⁾

1) (continued) Analysis of the Objectives of American Monetary Policy", Journal of Finance, June 1968, pp. 465 - 479.

2) Needless to say, this does not at all exclude the fact that the behavior of the authorities may be effected by the balance of payments.

(c) Havrilesky's attempts

In an effort to resolve the problem of the constant (or controllable) money multiplier implied by the DJ model, Havrilesky¹⁾ tried to find "an indicator of monetary policy which is--expected to be free from--market phenomena which are independent of monetary policy".²⁾ For such an indicator he proposed the total reserves (required reserves + free reserves) held by commercial banks. The reaction function estimated by him was:

$$R = 9754 + 20 Y + 152 U - 10(p - p^*)^2 - 138 i - .05 B ,$$

(643) (1.3) (50) (4.5) (53) (.06)

where R denotes total reserves, p^* the target price level given exogenously and i the average government long-term bond yields. (The remaining symbols in the equation have basically the same meaning as the DJ denotation).

Several critical comments are in order. First, it is not clear that the choice of total reserves rather than the money supply is an essential improvement of the theory. Although the choice of total reserves as the monetary policy indicator avoids the problem of the "fixed" money multiplier assumed by DJ, it is doubtful whether total reserves themselves are not affected by market forces which are independent of monetary policy. Havrilesky, in fact, admits this doubt but justifies his approach by allowing authorities' claims that they have "considerable experience in compensating for these influences."³⁾ No further evidence is brought forward to justify this choice of indicator.

1) Havrilesky, Thomas, "A Test of Monetary Policy", Journal of Political Economy, (June 1975) pp. 299 - 304.

2) Havrilesky, op. cit., pp. 299 - 300.

3) Havrilesky op. cit., p. 300.

In fairness to Havrilesky it should be noted that his contribution lies in the fact that he specifies his reaction function as quadratic with respect to differences between the price level target and the actual price level. Although this specification was introduced on somewhat ad hoc grounds, it would certainly be worth testing.

2. The Theil Approach

(a) The model

The reaction function estimated by the RDJ approach is an empirical one in that it states only the empirical relationship to be observed between a policy variable and a set of target variables. The specification is more or less ad hoc and, taken as such, does not assure that the authorities regard the estimated relationship as a structural one. Therefore, the estimated reaction functions, taken independently, may do no more than describe objectively the past behavior of the authorities. Also, the estimated reaction coefficients may not allow further investigation into the structure of the authorities' decision making.

Theil proposed an alternative model¹⁾ of the authorities' decision making process which allows us to interpret the meaning of the estimated reaction coefficients. According to him, the authorities are assumed to minimize (maximize) a cost (welfare) function which depends on the difference between (a) the actual and desired values of the policy target variable and between (b) the actual and desired values of the policy tool variable:

$$C = (Y - Y^*)' W(Y - Y^*) + (X - X^*)' V(X - X^*) \quad (1-4)$$

1) Theil, op. cit.

Where C stands for the cost (or welfare), Y denotes a vector of policy target variables and X a vector of policy tool variables, while X^* and Y^* denote respectively their desired levels. W is a matrix (symmetric) of positive weights attached to the deviations of the target variables from their desired values, and V is a matrix (symmetric) of positive weights attached to the deviations of the policy variables from their desired values. For practical purposes, the matrices W and V are assumed to be not only symmetric but also diagonal (see below).

Suppose the reaction of target variables to policy variables is somehow known to the authorities, so that the behavior of the target variables may be specified as a function of policy variables and other exogenous variables:

$$Y = AX + BZ \quad (1-5)$$

The problem may now be stated as a constrained minimization of the cost function (1-4) subject to (1-5).

$$(Y - Y^*)' W(Y - Y^*) + (X - X^*)' V(X - X^*) - \lambda (Y - AX - BZ)$$

Where λ is the Lagrangean multiplier. Recognizing that $\frac{\partial Y}{\partial X} = A$, the solution for optimal decision-making is:

$$X = X^* - V^{-1}A'W (Y - Y^*) \quad (1-6)$$

If appropriate assumptions are made as to setting of X^* and Y^* , the authorities' reaction function may be estimated as (1-6) by assuming random errors in their policy. The estimated reaction coefficients are an amalgamation of the weights matrices V and W and the reaction of the private sector to the authorities' behavior (A).¹⁾

1) Although the model (1-4) and (1-5) is stated in static terms, it is easy to extend it to (to the next page)

(b) Empirical applications of the Theil model:
two interpretations

The reaction function (1-6) makes it possible to interpret further the meaning of the estimated reaction coefficients. If, in particular, the matrix A is known, one may make some statement about V and/or W. On the other hand, if we have some information about V and W, it would be possible to make some statements about A.

Friedländer tried to draw some conclusions about V and W by using a large econometric model (MIT-FRB model) to obtain the coefficient of A. If A is known as A^0 , then the problem is to solve the simultaneous equations for V and W:²⁾

$$V^{-1}A^0'W = \hat{R} \quad (1-7)$$

Where $\hat{R}$ is the estimated vector of the reaction coefficients. Although equation (1-7) may not in general uniquely determine the entries of V^{-1} and W, a unique solution is possible in some cases if the matrices are diagonal (or symmetric) and if a proper number of policy targets and tools are chosen.

From this model, Friedländer estimated a set of reaction functions for government expenditures, the personal tax rate, the corporate tax rate and open market operations. With respect to the desired levels of target and policy variables (X^* and Y^*), she used published government documents. (For instance, the desired GNP was taken as

1) (Continued) include dynamics. See Theil, op. cit., and Jonson, Peter, "Stabilization Policy in Australia: An Objective Analysis", The Manchester School, September 1974 pp. 259 - 276.

2) Friedländer, Ann F., "Macro Policy Goals in the Postwar Period: A Study in Revealed Preference," Quarterly Journal of Economics, Feb. 1973, pp. 25 - 43.

defined by the Council of Economic Advisors in their 1967 Economic Report of the President; the desired size of the open market operations was inferred from the Open Market Committee minutes, etc.)

According to Friedländer's results, the Eisenhower administration put relatively more emphasis on price stability than did the Kennedy-Johnson administrations. Both administrations, however, put relatively more emphasis on this target than on full employment, while neither attached much importance to the income growth target. This information results from the W matrix; no information was drawn from the estimated V matrix according to Friedländer since "the weights attached to the policy instruments were insignificant...."¹⁾ In fact, no results on the V matrix are reported because the estimated entries of this matrix are not significantly different from zero.²⁾ As we shall see later, this is an important point, one which casts doubt upon the reliability of her results.

Another sort of statistical inference is possible if we make a different assumption about the structure of the economy. As has been described above, the crucial assumption of the Theil model is that policy authorities have available the reduced form equations of the economy (1-5). Friedländer identified the reduced form equations with an econometric model that the government had available.

Instead of interpreting equations (1-5) in this way, one may be allowed to interpret them as summarizing "the presumably complicated official view of the economic structure".³⁾ This is the interpretation used by Jonson for making inferences with respect to A, rather than with respect to V and W.⁴⁾ In passing, it is worth pointing out

1) Friedländer op. cit., p. 40.

2) See Friedländer, op. cit., p. 33.

3) Jonson op. cit., p. 260.

4) Jonson, op. cit.

that such an approach is quite in line with the spirit of the policy mix theory whose essential prescriptions consist in assigning a policy tool to a target whose response to the tool is relatively largest. In the present context the extent to which a policy target responds to a policy tool is summarized by the A matrix. Therefore, one may judge if the authorities have acted as if they believed a certain tool has a comparative advantage for influencing a certain target. This is done by taking the estimated reaction coefficients matrix R:

$$\hat{R} = V^{-1}A'W,$$

and dividing each element of the rows of the matrix by the corresponding elements in the first row. Since the (i, j) element of the R matrix may be expressed as (assuming V and W are both diagonals):

$$R_{ij} = \frac{w_j}{v_i} a_{ji}$$

such a division would give

$$\frac{R_{kj}}{R_{lj}} = \frac{v_l}{v_k} \frac{a_{jk}}{a_{jl}} \quad (1-7)$$

From (1-7), we may know (by fixing l and k, the policy instruments) the relative magnitude of the ratios a_{jk}/a_{jl} ($i = 1 \sim$ number of the policy targets). This approach was used by Jonson for evaluating the stabilization policy of Australia. He concludes, among other things, that Australian policy makers have acted as if they believed that interest rate changes had a comparative advantage for influencing external balance and that fiscal policy had the advantage for controlling prices. Notice that the change in the interpretation of the A matrix (private sector's responses to authorities' behavior) has completely changed the problem to be solved. In Friedländer's case, the problem is to make an inference from

the V and W matrices, while Jonson's approach tries to infer the government's beliefs about the response of the private sector to policy changes - not necessarily the actual behavior of the private sector.¹⁾

3. A critical review of the Theil approach

(a) An appropriate interpretation

Although Theil's approach gives a useful clue to the meaning of the estimated reaction coefficients of the authorities, there are some points on which a number of critical comments may be made. To do this it is necessary to review the basic assumptions of the Theil's model.

We begin by examining the meaning of (1-5), which is the restriction on the cost minimization (welfare maximization) problem. That the meaning of this restriction is somewhat ambiguous has already been stated in relation to its two different interpretations by Friedländer and Jonson. In the former case (Friedländer), the authorities have to know the actual structure of the economy in order to derive the reduced form restrictions on their cost minimization behavior. Such an assumption is doubtful.

In contrast, to interpret the reduced form restriction as simply stating the official view of the actual economy, as Jonson does, appears more reasonable. To be sure,

1) In fact, this is precisely the problem with Jonson's approach. Let A_g denote what the government calculates as the private sector's response. A_g may not be identical with the private sector's actual response, denoted as A_p . In such a case the result of any government policy will be different from what the government had expected, thus forcing the government to eventually change A_g . Ideally, Jonson's model should be testable whether such an error learning process has already converged. Otherwise, his model should incorporate this error learning explicitly.

there is no a priori reason why such an official view is identical to (econometric estimates of) the actual economy. It would, therefore, be plausible to follow this line and, instead of examining the weights attached to policy targets and tools, make some inferences about the official view of the actual economy. For this reason, Jonson's interpretation of the Theil model will be considered the more appropriate one.

(b) Problems: the cost function

It is to be noted, however, that one should reexamine the assumptions of Theil's model before comparing different interpretations of it; and it is here that some basic problems arise. Theil's cost function takes the following form:

$$C = (Y - Y^*)' W(Y - Y^*) + (X - X^*)' V(X - X^*) \quad (1-4)$$

Let us examine the characteristics of the assumed cost function. The fact that it has no linear terms is not a restriction, because any quadratic form may be written, by redefining variables, in the form that does not include the linear term.

Further, V and W may be regarded as diagonal so long as each policy tool variable is controlled independently instead of jointly, and each policy target variable is dealt with in the same way.¹⁾ Although the cost function does not include interaction between the target and instrument variables (there are no XY terms in (1-4)),

1) Suppose M denotes the monetary policy and F the fiscal policy. A non-diagonal V matrix implies that $\alpha M + \beta F$ and $\gamma M + \delta F$ (α, β, γ , and δ are appropriate weights) are the policy variables and not M and F . The same applies, with necessary changes, to the policy target variables.

this is reasonable from an economic point of view. Thus, the cost function (1-4) is expressed as a sum of two terms: the first concerns the cost associated with the policy target and the second, the instruments.

It is however a restriction that the cost function should be written as in (1-4). In particular, it is essential that it contain not only policy targets (Y's) but also policy tools (X's) and, therefore, that V be different from a zero matrix. This assumption--that the cost function is expressed in terms of X's--is somewhat doubtful. As Friedländer herself states, "One would generally expect the weights attached to...instruments to be relatively small.¹⁾" The reason why V cannot be a zero matrix may be seen by inspecting equation (1-7) which shows the estimated reaction coefficients as a function of the inverse of V. If V is a zero matrix, it is evident that V^{-1} has no meaning at all.

While it is clear that the mathematics of Theil's approach requires V to be non-zero, it is not so obvious, from an economic point of view, that the cost function should be expressed in terms of the policy tools. Suppose a policy tool (say, the official discount rate) is different from its desired level. Theil's cost function assumes that because there is a difference between the actual value of the policy variable and its desired level, a cost is involved. Why can't the authorities change the value of the policy variable to the desired level²⁾? Or assuming, at least, that they cannot do so immediately,

1) Friedlander, op. cit., p. 33

2) Notice that the V matrix refers to the cost associated with the actual (static) difference between the actual and desired values of the policy tool variable, and not to the cost associated with the movement from the actual to the desired values. Even if the latter cost-dynamic cost - is included explicitly, it still remains true that V (static cost is essential in Theil's model.

why should a deviation be included in the cost function? From the standpoint of the authorities, it is much more natural to assume that the difference between the actual and desired values of the policy target ($Y - Y^*$) determines the desired level of the policy tool (X^*) and that they will try to eliminate the difference between the actual value of the policy variable (X) and its desired level. It is only by way of influencing the policy target variables that the policy tool variables influence the cost (welfare) of the economy.

In this context it is interesting to note that Friedländer expects the weights attached to the policy tools to be relatively small. Indeed, she even reports that these weights are empirically zero.¹⁾ There is a self-contradiction here because she reports the W matrix (weights attached to the target variables) while claiming that the V matrix is in fact zero. This completely violates the assumptions of Theil's model.

Basically, the same kind of criticism applies to Jonson's interpretation of Theil's model. Since it is not possible to guess the magnitude of V_1 and V_k (see (1-7)), it is in general impossible to know whether the left-hand-side of (1-7) (R_{kj}/R_{1j}) makes any sense. One has simply to postulate that the V_k and V_1 are significantly different from zero, and there is no way to check whether such a postulate is justified.

4. Conclusion

In concluding this chapter, it is suggested that the stabilization policy of the authorities, and its appraisal, could be carried out most efficiently if the authorities' behavior were estimated simultaneously with that of the

1) Friedlander, op. cit., p. 33.

private sector. In chapter 3 such an approach is developed and analyzed in some detail. An abstract model of the behavior of the private sector together with a set of reaction functions describing government policy will be specified. Since the discussion in the present chapter has shown Theil's model to be based on assumptions which, from the point of view of this paper, are not satisfactory, the RDJ approach will be applied for specifying these reaction functions.

Chapter 2

EQUILIBRIUM AND DISEQUILIBRIUM ANALYSIS

The purpose of this chapter is rather methodological, and perhaps even semantic. We will discuss tâtonnement, non-tâtonnement, stocks and flows and so on.

The reason such a chapter is necessary is "historical". During the preparation of this thesis, various empirical studies appeared using what was called "disequilibrium" specification extensively for behavioral equations.¹⁾ The purpose of this chapter is to show why this new approach is not employed here, by pointing out some basic difficulties associated with the "disequilibrium" approach. The discussion to follow, however, will also clarify these cases where the "disequilibrium" approach is appropriate. Thus, the other extreme, which claims that the disequilibrium approach is nonsensical, will also be criticized.

1. Equilibrium and Disequilibrium Approaches

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- 1) See for instance C. Wymer, "Continuous Time Models in Macro-Economics: Specification and Estimation" (Paper prepared for the SSRC-Ford Foundation Conference on Macroeconomic Policy and Adjustment in Open Economies "at Fanhams Hall, Ware, England, Apr. 28 - May 1, 1976) and the literature quoted there in.

(a) Equilibrium Analysis

Traditionally, the "equilibrium" approach starts by postulating that the actual economic data have been somehow generated by demand-supply equality. Thus, the equilibrium is defined as those values of D, S and P that satisfy

$$D = \tilde{D}(P; \alpha, \beta \dots) \quad \dots (2-1)$$

$$S = \tilde{S}(P; \gamma, \delta \dots) \quad \dots (2-2)$$

$$D = S$$

where D (S) is the quantity to be demanded (supplied) and P the price. α , β etc denote the exogenous variables that shift the demand and the supply curves.

In contrast to the traditional approach, the disequilibrium approach starts from a different postulate. In particular, those disequilibrium approaches widely used by the empirical studies noted above generally postulate that the actual economic data have been generated by a differential adjustment process such as

$$\frac{dP}{dt} = \alpha [\tilde{D}(P) - \tilde{S}(P)] \quad \dots (2-3)$$

where α is the "speed of adjustment".

The two approaches may at first appear to be quite similar. After all the "disequilibrium" approach might be regarded as a "short run" version of the equilibrium approach; the former seems to apply the data observed at relatively short periods of time, for, presumably, the shorter the observation interval, the less likely that these data have been generated by the demand-supply equality. What we will try to show in this chapter is that such is not the case; and that behind the two (seemingly similar) approaches exist fundamental methodological differences.

In addition to the close connection between the

equilibrium approach and the tâtonnement postulate, one has to bear in mind the importance of the relationship between the correspondence principle and the tâtonnement postulate. In particular, the "dynamic postulate", which is employed by the correspondence principle to derive meaningful comparative statics results, relates in an important sense to the tâtonnement postulate.

To demonstrate this problem more clearly, suppose the following "dynamic postulate" which asserts that the price increases when the excess demand at the current price is positive:

$$\frac{dP}{dt} = \alpha [D(P) - S(P)] \quad \dots (2-4)$$

where P is the price. To obtain the meaningful comparative statics, this dynamic equation must be stable.

One may observe the similarity of (2-4) to (2-3). This similarity is only occasional however, once one considers the meaning of the price P in (2-4).

What kind of price is it? Clearly, it is not the actual price of the commodity, or the actual price we observe as economic data, because we postulate that the actual price is generated by the equality of demand and supply, not, as might be suggested by (2-4), by the inequality between D (P) and S (P). By assumption and especially by virtue of having postulated the tâtonnement adjustment mechanism, we have excluded the possibility of interpreting (2-4) as a description of the actual and observable pricing process in the market.

The meaning of requiring stability to the dynamic equation (2-4) is now become apparent. Such a requirement is certainly necessary to guarantee the existence of the actual (observable) data. Unless we can somehow bridge the P appearing in (2-4) to the actual (observable) P, we cannot interpret the observable P (and other variables such as D, S etc) as having been generated by demand-supply equality. Thus, as theoretical devices, the tâtonnement

postulate, equilibrium analysis and the Correspondence Principle all point to the same direction: they are necessary in order to interpret the data as equilibrium values.

Admittedly, such a way of reasoning has many shortcomings. In a way, the whole argument above is somehow cyclical, possibly creating a completely imaginary story of the function of the market. However, it must be noted that the above argument offers a logically consistent background to the employment of equilibrium analysis. As we shall see below, the disequilibrium analysis does not necessarily share such logical consistency.

(b) Disequilibrium Analysis

Contrary to the equilibrium analysis, the disequilibrium analysis starts by postulating that the actual data are not necessarily generated by demand-supply equality. In our context, this means that the equation (2-3) (not (2-4)) is assumed to describe the actual pricing process of the market; and therefore the price in this equation (and the other variables too) is generally regarded as observable. Moreover, the specification of the equation (2-3) implies in general that either the supplier or the demander (or both) are beyond their respective supply or demand curves. Noting that these curves have presumably been derived from some maximization postulates, the "disequilibrium" approach specified by the equation (2-3) implies that economic agents are not always in a position to maximize their utility or profit (except in the long run where the right hand side of (2-3) is zero).

The fact that the "disequilibrium" approach may lead to the denial of one of the most basic postulate of economics--the maximization principle--requires that one should be very careful in applying it. To be sure, risk, uncertainty, transportation costs, imperfect information

(and all the other elements that are not always incorporated in usual economic analysis) may give rise to the necessity of using "disequilibrium" analysis; but these elements should ideally have been considered at the stage of deriving the demand-supply curves. The use of the "disequilibrium" approach on the basis of the existence of these elements is at best a short-cut way of describing the actual pricing process; the logical basis of using the disequilibrium approach in this particular case is rather weak.

In addition to these problems, there are further difficulties associated with the "disequilibrium" approach. They become apparent when one specifies dynamic equations like (2-3), because some element of arbitrariness is inevitably involved. In order to see the point clearly, one has only to think of specifications of the pricing process alternative to (2-3). For instance, one may think of:

$$\frac{dP}{dt} = \alpha [D(P) - Q] \quad \dots (2-5)$$

$$\frac{dP}{dt} = \alpha [Q - S(P)] \quad \dots (2-6)$$

$$\frac{dP}{dt} = \alpha [D(P) - Q] + \beta [Q - S(P)] \quad \dots (2-7)$$

etc. Q denotes the actual quantity to be transacted. Notice that (2-5) assumes that the price is determined as a function of the difference between the "desired quantity of consumption" ($D(P)$) and the actual quantity of transaction. (2-6) specifies to the contrary, while (2-7) is a combination of the above two. These specifications are of course not at all exhaustive, and they are all, to some extent, arbitrary. Depending on what kind of dynamic equation is formulated, theoretical analysis based on the disequilibrium method would produce completely different results, not only with respect to the dynamic adjustment path, but also to the position of steady state

equilibrium.

2. Where Disequilibrium Analysis is Appropriate

(a) Stock-flow problem

The discussion up to now might make it doubtful whether one should really take the "disequilibrium" approach seriously. There are however some cases where such an approach is still logically consistent. These relate to the stock-flow problem.

When we use mixed stock-flow models, we sometimes encounter a situation where we have to assume a certain dynamic equation that describes the way the adjustment of stocks (which by necessity should be carried out in terms of flows through time) would take place. Although we could find a price variable (like the interest rate) that equates the actual demand for stocks (say, money) with supply, this is not always the case. Thus, in some cases it is appropriate to specify such a relation ship as:

$$\frac{dS}{dt} = \alpha [S^*(...) - S] \quad \dots (2-8)$$

where S is the actual holding of a stock variable, and S^* is its desired level that depends on a number of variables.

One might want to specify the same sort of dynamic adjustment hypothesis with respect to flow variables. It is, however, less reasonable to assume such a relationship with respect to flows. If demand (or supply) function is defined as flow function, it should by definition mean that a specific quantity of a good is demanded (supplied) within a certain period of time at a certain price. Without certain assumptions such as expectations lag etc, the use of the specification of the type (2-8) with respect to flow-variables is relatively difficult to defend.

(b) Some Examples

The reason why in some cases it is reasonable to assume a dynamic adjustment hypothesis as a behavioral relationship while in others it is not, is a rather technical one. If an economic model includes both stock and flow variables, and if we may not be able to find a price variable that would presumably equate stock demand with its supply, we would have to assume a dynamic quantity adjustment hypothesis with respect to changes in stock variables. Such an example may be seen in a model of the balance of payments. Consider the following:

$$\bar{y} = e + \frac{1}{p} \frac{dM}{dt} \quad \dots (2-9)$$

$$\frac{dM}{dt} = \alpha (kpy - M) \quad \dots (2-10)$$

$$M = R + \bar{C} \quad \dots (2-11)$$

This model determines the nominal money stock (M), the level of foreign reserves (R) and the real expenditure (e), on the assumption that the level of real income (y), the price level (p) and the level of nominal domestic credit (C) are exogenous. With respect to capital transactions, we may alternatively regard the level of foreign interest rate as exogenously given and constant so that there are no foreign capital transactions or that there are simply no international security transactions. In any case, there is no price variable that equates the actual money stock with its demand because the desired level of money stocks is determined by Marshall's k (constant), p and y which are all exogenous. A reasonable specification is to postulate a dynamic stock adjustment hypothesis like (2-10) and relate this to flow variables by way of (2-9).

The basic reason why the model (2-9) - (2-11) could reasonably assume a differential adjustment hypothesis is that this model does not have a price variable that would

presumably achieve an instantaneous equilibrium between stock money demand and supply. If instead the money market equilibrium condition had been specified as:

$$M = f(r, y) \quad \dots (2-10)'$$

and if (A-9) is replaced by

$$y = e(r, y) + \frac{1}{p} \frac{dM}{dt} \quad \dots (2-9)'$$

then (2-9)', (2-10)' and (2-11) would constitute an equilibrium model of the balance of payments that determines M , r and R simultaneously. These two models would offer different explanations of the same data on the balance of payments adjustment process; and their respective value may be judged only empirically.

3. Conclusion

This chapter has dealt with a rather semantic issue of what should be meant by equilibrium and disequilibrium analysis. In the latter part of the chapter, it was shown that there are some cases where the disequilibrium approach might be appropriate. Important among these is the case of a mixed stock-flow model. It is to be noted however that even in this case the basic reason why one might opt for the "disequilibrium" model is that we may sometimes be not able to find appropriate price variable (like interest rate) that would instantaneously achieve equilibrium of the market. Justification of the use of the "disequilibrium" approach is thus a rather technical one. It may be that the "disequilibrium" model should in fact be more appropriately termed the "differential adjustment" model.

Chapter 3

REACTION FUNCTION APPROACH AS APPLIED TO POLICY MIX

This chapter presents a broad outline of the econometric model which will be used in later chapters. It will be shown that the model is an econometric application of Mundell's policy mix model to macro-economic policy formation. A simple prototype model will be shown, and its application to econometric studies will be discussed. Further characteristics of the model will then be described with reference to the meaning of stability in our framework. It will become apparent that some of the discussion in Chapter 2 has been useful in specifying this model. The latter part of the chapter will be devoted to a brief discussion of the specification of reaction functions and their implications.

1. Policy mix theory

(a) Mundellian policy mix

Our model derives directly from Mundell's policy mix model.¹⁾ It is assumed that changes in policy instruments

1) Mundell, op. cit., ch. 14.

(a and b) depend on the values taken by policy targets X and Y, which in turn depend on the policy instruments. Mathematically, such a system is represented by the following differential equations:

$$Da = X(a, b) \quad (3-1)$$

$$Db = Y(a, b) \quad (3-2)$$

where D denotes $\frac{d}{dt}$, i.e., a change in the related variable during a unit of time. If "a" stands for a stock variable, Da has a flow dimension; if a is a flow variable, Da represents a change in the rate of flows, and so on. X and Y denote functions relating policy targets to policy instruments. It is assumed that the instrument variable a is assigned to the target variable X, and b to the target Y.

In order for the linear version of the system (3-1) and (3-2) to be stable it must be true that:

$$X_a + X_b < 0 \quad (3-3)$$

$$X_a Y_b - X_b Y_a > 0 \quad (3-4)$$

where X_u ($u = a, b$) denotes the partial derivative of X with respect to u.

In a more complicated interrelationship between targets and instruments, the system (3-1) and (3-2) may be generalized as follows:

$$Da = \alpha X(a, b) + \beta Y(a, b) \quad (3-5)$$

$$Db = \gamma X(a, b) + \delta Y(a, b) \quad (3-6)$$

where α, β, γ and δ denote respectively the weight of importance given by each authority to X and Y. The linear system of (3-5) and (3-6) is:

$$\begin{bmatrix} Da \\ Db \end{bmatrix} = \begin{bmatrix} \alpha & \beta \\ \gamma & \delta \end{bmatrix} \begin{bmatrix} X_a & X_b \\ Y_a & Y_b \end{bmatrix} \begin{bmatrix} a - a^* \\ b - b^* \end{bmatrix} \quad (3-7)$$

where a^* and b^* denote the steady state values of a and b respectively. If a priori knowledge gives us information as to the relative magnitude of $\begin{bmatrix} X_a \\ Y_a \end{bmatrix}$ and $\begin{bmatrix} X_b \\ Y_b \end{bmatrix}$, we could make the whole system stable by assigning an instrument completely to one of the two targets and another instrument to the other target. If we know, in addition, the numerical values of $\begin{bmatrix} X_a \\ Y_a \end{bmatrix}$ and $\begin{bmatrix} X_b \\ Y_b \end{bmatrix}$ respectively, we may allow all the weights to take non-zero values and still obtain a stable system. In any case, the assignment rule requires that an instrument be assigned to the target on which it has the greatest relative effect.

(b) Applying the policy mix theory to empirical problems

The policy mix problem above, as stated originally by Mundell, is largely a theoretical issue. For this reason the problem is presented in a relatively simple way: for instance, the equations (3-5) and (3-6) are expressed in a sort of reduced form where the only endogenous variables appearing explicitly in the model are the policy instruments. The policy targets are behind the scene and the interrelationship between the target and instrument variables is dealt with only implicitly.

In order to use the model in more empirically oriented studies, it is necessary to specify explicitly the relationship between the target and instrument variables. This may be done by rewriting the model (3-5) and (3-6) as follows:

$$Da = \alpha X + \beta Y \quad (3-8)$$

$$D_b = rX + \delta Y \quad (3-9)$$

$$X = X(a, b) \quad (3-10)$$

$$Y = Y(a, b) \quad (3-11)$$

where X and Y , as distinguished from $X(a, b)$ and $Y(a, b)$, express the actual values taken by the target variables. We may call equations (3-8) and (3-9) the policy authorities sector and (3-10) and (3-11) the private sector, where the dynamic behavior of the latter is completely determined by the former. Notice that in such a specification the private sector's equations are reduced form equations; the private sector variables X and Y are expressed as functions only of the instrument variables which are, from the standpoint of the private sector, determined exogenously by the authorities. If we want to express the private sector's behavior in structural form, equations (3-10) and (3-11) will generally be expressed as:

$$X = f(X, Y, a, b) \quad (3-10')$$

$$Y = g(X, Y, a, b) \quad (3-11')$$

where f and g are functions showing the behavioral relationship that exist among variables in the model. Thus f and g may denote the consumption function, a capital accumulation equation, a money demand function or some equilibrium relationship as well as budget constraints.

In contrast to the interpretation of (3-10') and (3-11'), it is not clear whether the authority sector's equations (3-8) and (3-9) denote a structural relationship or a sort of reduced form. If interpreted as a structural form, they assume that authorities behave in order to stabilize the behavior of the private sector, and the economic stabilization target is the sole determinant of the behavior of the authorities. If interpreted as a reduced form, however, the equations assume that there are in general some structural relationships among X , Y , a and b as follows:

$$D_a = f(X, Y, a, b, \dots) \quad (3-12)$$

$$D_b = g(X, Y, a, b, \dots) \quad (3-13)$$

and these equations should have been derived from more basic considerations as to the authorities' utility (or cost) function, budget constraints that restrict their behavior, and the other constraints over which they have no control.

As was discussed in chapter one, we have not reached the stage in general theory where we can explain the behavior of the economic authorities in a convincing way. That is the reason why rather ad hoc specifications will be chosen for the authorities' behavioral equations. Thus, whatever specification may be employed, we cannot be sure whether the particular specification is really an appropriate one or not. The fact that we cannot in general base our "reduced form" equations (i.e. eq. (3-8) and (3-9)) on the basis of some "structural form" (i.e. (3-12) and (3-13)) may involve serious specification errors that could eventually cause poor estimates of the behavioral equations of the authorities. What if, for instance, the authorities were not in fact motivated by the inflation rate, unemployment ratio and other economic variables which we would expect to include as arguments of the behavioral equations of the authorities? What if, in contrast to these variables, the authorities were motivated by a completely different set of variables such as elections, dignity, vanity and so on?

That question can be answered simply by noting the purpose of studying the behavior of authorities: what we want to know is not necessarily the ultimate determinant of authorities' behavior; we want to discover, rather, the economic consequences of their behavior--whatever the motivation. For this purpose we have only to choose target variables and examine the empirical relationship between them and the behavior of the authorities. Though the assumed relationship may be a poor representation of the

behavior of the authorities, we may still study the economic consequences of this relationship by solving the private sector equations simultaneously with the authorities' equations. In short, the only thing we require with respect to the authorities is that they behave as if they were trying to affect the private sector. Even if (3-8) and (3-9) have nothing to do with the behavioral determinants of the authorities--if, for instance, the values of policy variables are in fact determined by completely non-economic considerations--it is still meaningful to study empirically the system (3-8) to (3-11), because it is the economic consequences of such policy making that our study tries to capture. Thus, a poor empirical fit of an estimated relationship between a policy target and a policy instrument variable does not necessarily mean that the theory (equation (3-8) or (3-9)) is meaningless.

In addition to the above, we know that macroeconomic policies are in fact affected (even greatly) by economic variables, and that the effect of non-economic factors is probably non-negligible. To the extent that policy variables are affected by economic variables, it makes sense to specify the relationship as (3-8) and (3-9) (hereafter referred to as reaction functions); and the fact that they are also affected by non-economic variables can be accounted for by introducing non-economic variables as exogenously determined variables.

2. Alternative costs of stabilization

The prototype of our model may be expressed linearly by the following:

$$DZ = CY \quad (3-14)$$

$$Y = AY + BZ \quad (3-15)$$

where Y (a vector) denotes the variables whose values are

determined by the private sector; Z, again a vector, the policy variables whose values are determined by the policy authorities; and D is the time derivative. A, B and C are coefficient matrices that are associated with Y and Z. By a simple substitution one obtains:

$$DY = [I - A]^{-1} BCY \quad (3-16)$$

or

$$DZ = C[I - A]^{-1} BZ \quad (3-17)$$

If the system (3-16) (or (3-17)) is unstable, it would be necessary to change some entries of the matrix $[I - A]^{-1} BC$. There are numerous possibilities.

To begin, one may try to change the entries of the $[I - A]^{-1}$ matrix. This involves basically any attempt to change the functional form or the parameters of the private sector's behavioral equations. Thus moral suasion with a view to change for instance banks' or businesses' behavior (the entries of A matrix) belong to this category. Or, the government might try to impose import quotas on traders. In such a case the marginal propensity to import becomes zero when the quota is exhausted. To some extent, such measures as tariffs, indirect taxation, special depreciation allowances to enterprises, may be classified in this category.

The drawback to policies designed to change the A matrix is that they may not be appropriate from the standpoint of the resource allocation theory, since the entries in this matrix presumably reflect the private sector's optimum choice under competitive market conditions. Unless there is a presumption that the actual market does not satisfy the conditions under which these optimal decisions by the private sector can be made freely (economies of scale, externalities, etc.), such direct interventions by the policy sector into the private sector should be avoided

In contrast, an attempt to change the entries of the B matrix may be reasonable to a certain extent. Since the entries of the B matrix represent the reactions of the private sector to policy actions, the policy makers may be able to change these responses by a program designed to let the private sector recognize more clearly and quickly the intentions of the government sector. In some cases, however, the contrary - obscurantism - might serve the purpose of economic stabilization.

In actual use, however, the scope for changing the B matrix will be quite limited. First, some of the relationships in (3-15) are in fact equilibrium conditions. As such, they cannot be altered by the authorities. The same is true for budget constraints which may also be represented in B. In addition to this, it may also be pointed out that an attempt to change entries of B may in fact mean an attempt to change $[I - A]^{-1}$ and should therefore, for the reasons described above, be avoided. To illustrate this, consider the relationship

$$C = \alpha(Y - T) \quad (3-18)$$

where C denotes the private consumption, α denotes the marginal propensity to consume and T the direct tax on income. If taxation is considered a policy variable, the private sector's response to taxation is $-\alpha$ which would appear as one of the entries of the entries of the B matrix. Therefore, the authorities cannot try to change the B matrix without affecting the marginal propensity to consume. To the extent that the entries of the B matrix reflect the private sector's optimum response to the policy authorities' behavior, direct interventions into the private sector should again be avoided in principle.

The remaining possibility is of course the C matrix. Indeed, it is the only reasonable way (in terms of economics, and especially in terms of the resource allocation theory) for the authorities to intervene in the

market for stabilization purposes. Although it cannot be properly treated in the present context, it should be emphasized that attempts to change the entries of C may entail some costs. Suppose for instance that the stabilization objective requires authorities to be more sensitive to the unemployment rate in their fiscal policy. Although this does not mean that the authorities would have to pay more for collecting information on the unemployment rate, it might mean that a more forceful fiscal policy is actually followed. It is not at all certain whether such a change in the attitude of policy makers is possible without causing a fundamental change in their policy rules (such as an abandonment of a balanced budget in favor of an issue of public debts). Strictly speaking, the cost incurred in changing the government reaction coefficient must be compared with the cost involved in changing the entries of A (or B) matrix. If the cost of the former, properly defined, falls short of that of the latter, stabilization should be effected by changing the authorities' reactions to the private sector variables.

3. Characteristics of the model

(a) Stability

This subsection deals with the formal structure of the reaction function model and its features. Our model will take the form shown by (3-14), (3-15) or (3-17):

$$DZ = CY \quad (3-14)$$

$$Y = AY + BZ \quad (3-15)$$

or

$$DZ = C \left[I - A \right]^{-1} BZ \quad (3-17)$$

where the notation has already been defined above.

Some comments on the specification of the model are in order. First, consider the meaning of stability in the framework of the model.

In comparative statics analysis, it is generally assumed that the system to be analyzed is stable in the tatonnement sense. In the framework of our model, such stability means that the matrix $[I - A]^{-1}$ is a stability matrix whose characteristic roots do not have any positive real parts.

It should be recognized that stability in the tatonnement sense has almost nothing to do with our model, since the stability here concerns that of the actual behavior (not of the tatonnement behavior) of the endogenous variables Y . The relevant "stability" is whether the system

$$DZ = KZ \quad (3-19)$$

$$(K = C [I - A]^{-1} B)$$

is stable; and it will immediately be clear that if K is a zero matrix, the system will indeed be stable because the only factor that makes the system (3-14) (3-15) dynamic is the fact that Z changes through time as a consequence of the reaction function (3-14). Thus if C is a zero matrix, K will be zero too, and we will always have a stable system if no policies are pursued by the government! It might even appear nonsensical to evaluate the actual stabilization policy, because no-reaction by the authorities can always stabilize the system. Such a result is a necessary implication of the model as long as all private sector variables (the vector Y) are instantaneously determined by the current values of the policy variables.

(b) Dynamics

In actually building econometric models, however, we often find that the factors that produce intertemporal dynamic behavior of the endogenous variables are not necessarily limited to policy variables. On the contrary, private sector variables also give rise to dynamics in general. To mention a few examples, consider the role of expectation. Suppose the private sector expects the price level to move according to the adaptive expectations hypothesis:

$$Dp^e = \alpha (p - p^e) \quad (3-20)$$

where p^e denotes the expected price, p the actual price and α the speed of adjustment. Then we have a dynamic element which is of purely private sector origin.

Another possibility is partial stock adjustment. As noted in the preceding chapter,¹⁾ there might be a case, especially when the model under study is a mixed stock-flow model, for specifying such behavior.

A further possibility arises in the framework of a mixed stock-flow model. If, for instance, the level of foreign reserves changes according to the balance on trade, we have the relationship

$$DR = X - IM$$

where DR is the balance of payments (assuming no international security transactions); X is the nominal value of exports and IM is the nominal value of imports. Thus, even when no stock adjustment hypothesis is assumed, there is still an inherent dynamic element originating from the private sector.

1) See equation (2-8)

As shown by the three examples above, there are in many cases some dynamic element not only in the policy authorities sector but also in the private sector. In other words, the presentation of the model (3-14) and (3-15) is not precise, because some of the elements of the Y vector in fact take the form DY , or the time rate of change in Y.

As noted above, the policy mix theory was developed mainly within a theoretical framework. As a result the size of the model has often been restricted to any minimum that would produce meaningful conclusions. Although such an approach may be correct in theoretical issues, it would be desirable to test the spirit of the policy mix theory in a more empirically oriented study.

The spirit of the policy mix theory will be tested in our model as follows: given the simultaneous estimation of the policy authorities and the private sector, we may first restrict the reactions of the authorities to nil and examine the characteristic roots of the resulting system. This provides a measure for knowing the dynamic stability of the behavior of the private sector, independent of the authorities. In comparison, we may examine the stability of the whole system by calculating its characteristic roots, including the authorities' reactions. By comparing the stability of the two systems, we may infer the extent to which the authorities have contributed to the stability of the whole system.

Furthermore, we may change the authorities' reaction coefficients and see whether such a change increases or decreases the stability of the whole system.

(c) The specification of policy reaction function

In relation to the particular specification of the model, it is necessary to recognize the following points.

It is assumed that the policy authorities adjust their stabilization policy by responding to the level of the private sector's variables. If, for instance, Y is replaced by $Y - Y^*$ where Y^* is the level of Y desired by the authorities (notice that this replacement does not cause any essential change of the model), the reaction function assumes that as long as the actual level of Y deviates from the desired level of Y the authorities will try to make up the deviation by changing the value of their policy instruments.

Notice that such a specification with respect to the authorities might involve a misspecification of their behavior because stabilization policies are not necessarily restricted to such integral policies. Derivative policies, proportional policies and so on may also be relevant in certain circumstances. Generally speaking, one has numerous possibilities in choosing a particular specification.

There are two reasons why we do not follow this line here and why we employ only the integral policy as the tool of economic stabilization. First, it seems desirable to restrict the specification of the stabilization policy as much as possible in order to make the model simpler. Although it might be worth trying a more complicated specification of the policy, possible complexities induced by doing so are sufficient reason to avoid it at this stage.

Secondly, if we employ only one class of possible stabilization policies, the integral policies will be the most appropriate. This is because only the integral policy, and not the derivative and proportional policies, may in general achieve the purpose of the authorities who wish to eliminate the gap between the actual and desired levels of the target variables. It is not necessary to follow a whole mathematical proof in order to recognize this point. Suppose a proportionate policy is being followed:

$$Z = \alpha (Y - Y^*) \quad (3-21)$$

Equation (3-21) specifies the government reaction as follows: to a given difference between the actual and desired values of the target variable there is a corresponding level of the policy variable. As noted above, the private sector variables of our model are determined in the long-run (in the sense that all the private sector originated dynamics have reached a steady state) by the policy variables. Suppose that such a state has been obtained and that there is still a difference between Y and Y^* . Although the authorities recognize that there is an actual discrepancy between the desired level of the target variable and its actual value, the proportional policy assumes that no further reactions will occur. A similar argument applies also to the differential policy. After all, it is only the integral policy that makes it possible for the authorities to obtain the long-run target of the stabilization policy. We assume that the authorities will always try to achieve the desired level of the target variables; and therefore the integral policy is assumed to be the specification of their behavior.

It is to be noted that in the steady state where DZ (not Z) is equal to zero, there should be a particular relationship among the private sector variables. This relationship is obtained by solving the simultaneous equations:

$$CY = 0 \qquad (3-22)$$

Solution of (3-22) makes explicit the pattern of combinations of the entries in Y that is considered to be desirable by the policy authorities. The reaction functions we specify imply that as long as the actual economy deviates from the desirable pattern, values of the policy variables are being changed so as to attain the desirable pattern. Thus the model is a variety of the forced growth model, at least with respect to the variables according to which the values of the policy variables are determined.

Recent studies of the policy reaction function in many countries have generally concentrated on estimating the reaction functions independently of the private sector and therefore are of limited value with respect to the use of their results in macroeconomic policy choices (although they are able to show explicitly the policy objectives of the authorities). If the gist of analyzing the behavior of policy authorities lies not only in reporting their behavior but also in utilizing the results for improving the performance of the economy, then the scope of reaction function analysis must be extended in this direction. A reasonable way seems to be to estimate simultaneously the equations describing the behavior of the private sector and the policy authorities. Not only does such an approach have an advantage of being free from possible simultaneous equation biases that accompany econometric models which treat policy variables exogenously--because we expect a priori that the correlation of the policy variables with the private sector variables would normally be quite significant--but it also allows us to perform some interesting policy experiments. One may, for instance, compare the stability of the economy as a whole including the reactions of the authorities and that of the private sector taken as such.

4. Conclusion

This chapter has summarized the way in which the reaction function approach may be combined with the activities of the non-authorities sector. The reaction function approach to be used in the later chapters is a very small subset of the reaction function approach in general, notably with respect to the possibly infinite number of plausible specifications of the authorities' behavior. It may even be claimed (on somewhat a priori grounds) that the authorities' behavioral pattern has

no regularity that can be tested empirically. Even if such an extreme view is rejected, the lack of a reliable theory of the behavior of the authorities makes it very difficult to find a reasonably correct specification of their behavior. The following chapters should therefore be understood as one possible attempt to apply the approach to empirical questions.

Chapter 4

GERMAN ECONOMIC POLICY 1960 - 73: POLICY TOOLS AND PERFORMANCE¹⁾

The purpose of this chapter is to give a reasonably detailed account of German economic policy between 1960 and 1973, with a view to preparing for the next chapter which will analyze econometrically German economic policy performance.

The first section deals with the traditional monetary policy tools which the German authorities have in command. The next section analyzes briefly the effectiveness and limits of these tools. The third section then describes some nontraditional tools such as the forward swap policy to curb international capital flows.

The fourth section analyzes the effectiveness of the exchange rate policy in relation to speculative activities in the international securities market. Following that is a brief account of fiscal policy, and then a section containing a verbal description of German economic policy between 1960 - 73.

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- 1) Statistical figures and facts referred to in this chapter are collected from the following: Deutsche Bundesbank, "Monthly Review", idem., "Statistical Supplements to Monthly Review"; OECD, Monetary Policy in Germany (OECD Monetary Studies Series, 1973). idem., La politique monétaire dans pays de la Communauté économique européenne (OECD, Paris 1972).; Yeager, Leland B., International Monetary Relations (2nd ed., New York, Harper and Row, 1976).

1. Monetary Policy Tools

(a) Discount rate policy

The discount rate policy has been used quite often in Germany. Under this policy, the Bundesbank discounts a limited category of securities at a rate fixed by itself. The securities eligible for the discount are mainly those issued by the federal or local government. On some occasions, the Bundesbank has also allowed some installment credit bills, bank acceptances (commercial bills) and so on. Preferential treatment of export bills, which was in practice before 1956, has long since been suspended.

In addition to the normal discount, the Bundesbank also allows occasional advances to private banks against collaterals of certain categories of securities. These advances, called the Lombard advances, are generally short term credits that should be paid back within 30 days. Collaterals required for the Lombard advances are the securities eligible for rediscount as well as other securities stipulated by the Bundesbank. The Lombard advance is regarded as applicable only to avoid temporary difficulties in the financing activities of the private banks, and the interest rate applied to it is set at one to three percent above the discount rate.

(b) Reserve requirement policy

The reserve requirement policy modifies the minimum reserve requirement ratio as applied to the deposits at the commercial banks. Depending on the moneyness of the category of deposits, the Bundesbank applies a higher reserve requirement ratio to liquid deposits such as demand deposits while a lower ratio is applied for saving deposits. Moreover, depending on the scale of each bank (measured by the quantity of each category of deposit), different

reserve requirement ratios are applied. When the reserve requirement ratio is not maintained by a bank, a penalty rate (3 points above the Lombard rate) is applied to the difference between the required reserves and the actual reserves.

The reserve requirement ratio as applied to residents deposits showed a monotonical decline between 1960 - 1969 (with a relatively minor exception between 1965 and 67). During this period, there does not seem to be any evidence that the reserve requirement policy was used for domestic countercyclical purposes. What seems to be a more reasonable interpretation is that the reserve requirement policy was used mainly to supply money along a trend which was determined by the real growth of the German economy. Since 1969, however, the reserve requirement policy seems to have been used for countercyclical purposes.

What is also apparent for the German reserve requirement policy is its asymmetrical use between residents deposits and non-residents deposits. The reserve requirement policy as applied to non-residents' deposits will be discussed below (4-3).

(c) Open market operations

The use of open market operations as a means of monetary policy has been less frequent than other policies especially before 1967. Until that time some restrictions were imposed on short-term interest rates, leaving the short-term security market underdeveloped. Thus open market purchase or sales of securities were in most cases transacted between private banks and the Bundesbank, leaving the policy almost identical with the discount rate policy, as far as the participants are concerned. Although since 1967 the Bundesbank has practiced an open market policy also in the long-term securities market, relatively frequent use of the policy occurred only between 1967 - 68.

Thereafter, the Bundesbank went back to the old attitude of not using the policy extensively. It is likely that the Bundesbank regarded the other policy tools at its disposal as sufficient means for monetary control.

2. Effectiveness of Monetary Policy

As we have seen in the preceding section, the main monetary policy tools were the discount rate policy, the reserve requirement policy and the open market operations policy. The policies that were used most frequently were the discount rate and the reserve requirement policy. Less importance was assigned to open market operations.

The effectiveness of these monetary policy tools depended to a great extent on a number of circumstances in which Germany found itself: first, one has to bear in mind the time span over which the authorities intend to have a command on target variables; secondly, the effectiveness of the policy is affected greatly by the openness of the economy. In this subsection, we will try to examine these points in turn.

(a) Time span

Consider a closed economy and the effectiveness of the monetary policy in this framework. The private sector has a liquidity preference schedule that is downward sloping with respect to interest rates, because at higher interest rates the public will hold interest bearing securities rather than cash.

The authorities try to affect the interest rate by changing the nominal money supply. When they announce that the official discount rate is set at a higher level than the current market interest rate, the private sector (banks) will try to buy securities in exchange for money.

The private banking sector will try to diminish their loans to the private non-banking sector to the extent that the accruals from allowing credit fall short of those from buying securities from the monetary authorities. In due course the monetary contractionary policy accomplishes its target and the market interest rate rises.

So far so good. It is to be noted however that whether the monetary policy has any effect on the real sector of the economy, or on the price level, or on other targets of the economic policy, depends on the structure of the economy itself. In the present framework, much of the effectiveness of the monetary policy depends on what happens to the price level. To illustrate this point, suppose that investment undertaken by entrepreneurs is mainly determined by their long run expectation of the accruals from real investment (real rate of interest). What would happen if the authorities raised the money rate of interest through their policy? To the extent that entrepreneurs diminish the investment flows from the level consistent with their long run expectations, *ceteris paribus*, there would be an *ex ante* excess supply in the goods and services market. The price level should decline in order to clear the market, while the real quantity of money, which has been initially reduced by the authorities by a reduction in the nominal quantity of money, will start to increase because of the decline in the price level.

The rise in the market interest rate, due to the discount rate policy, cannot be maintained for long because the decline in the price level increases the real amount of money. The economy will gradually shift on the liquidity preference schedule to the original equilibrium point where the real rate of interest--consistent with the long run expectations of entrepreneurs--is the same as the market rate of interest. What the reduction in the nominal quantity of money has achieved in the long run is merely a decline in the price level, while all the real variables will have eventually returned to the original level.

As shown in the above example, the effectiveness of monetary policy is different for the short run and the long run. If the time span over which the authorities wish to have command is relatively short, they may reasonably expect their policy have an effect. However, this does not necessarily mean that through monetary policy they will be able to control the long run growth of the economy.

(b) Openness of the economy

Now assume an open economy and observe what happens to the effectiveness of monetary policy. In so doing it is further assumed that the economy is small, so that the foreign price of traded goods is given by the world market. Also, all goods are traded so that if the foreign exchange rate is fixed, the currency price of goods and services is given in terms of the domestic currency.

By "openness", we mean that both current account transactions and capital account transactions are liberalized. Therefore the small country assumption means that not only the price of goods and services (in terms of the foreign currency) is given but also the interest rate.

Tables 4-1 through 4-4 summarize the balance sheets of the central bank, private commercial banks, private nonbank enterprises and the government (which includes households).

Central Bank	
FR	H
CL	

Tab. 4-1

Government	
Accumulated	C
budget	
deficits	

Tab. 4-2

Commercial banking		Private nonbanking	
H	D	D	DBL
FBL			Accumulated (disposable
DBL			income -
C2			-private absorption)

Tab. 4-3
Tab. 4-4

The notation is as follows: FR is foreign reserves; H, highpowered money; C1 and C2 refer respectively to that part of the total public debt (C) held by the central and commercial banks; FBL is the banking sector's total claims on nonresidents (negative, if liabilities); DBL is the banking sector's total claims on private residents; and D, demand deposits held by the nonbanking residents at commercial banks.¹⁾

1) If we further integrate Tables 4-2 through 4-4 we get the following table.

Private + Government	
H	(Accumulated
	disposable income -
FBL	- private absorption)
	+
	(Accumulated
	budget surplus)
	+
	Cl

Noting that (disposable income - private absorption) plus (budget surplus) is nothing but the balance on current account, the liabilities side of the table reduces to the accumulated current balance surplus plus Cl. Thus, if one integrates Tab. 4-1 (to the next page

In thinking of the effectiveness of monetary policy one has to bear in mind that under the assumed small country conditions monetary policy may not affect the interest rate which is exogenously determined.¹⁾ Thus, what monetary policy may do (without affecting the free transactions of securities in the international market) is attempt to affect D, which is the deposit currency held by the nonbank public at the private banking sector. In attempting to do so, the authorities try to change H, the high-powered money, which they then expect to have an impact on D.

To the extent, however, that the liquidity preference reflects the private sector's preference for the division of wealth between noninterest-bearing assets ($H + D$) and interest-bearing assets ($DBL + FBL$), and to the extent that this division is governed by the exogenously given interest rate, the authorities may not be able to affect the absolute values of $H + D$ and $DBL + FBL$, because the total amount of private monetary assets (= money stocks + securities = $H + D + DBL + FBL$) is again predetermined by the exogenously given interest rate. If the authorities increase C1 by purchasing securities from the private sector, the resulting increase in H will be short-lived because the private (banking) sector will soon purchase domestic or foreign bills in the international market, thereby restituting the portfolio balance. The result will be an unchanged H while the $FR/C1$ ratio will have declined, due to a capital outflow associated with the portfolio adjustment of the private sector. As long as the foreign exchange rate is fixed, as we have assumed, the long-run effect of monetary policy is merely to exchange foreign

1) (Continued) with this table one gets a definitional equation that the accumulated balance of payments is the sum of accumulated balances on the current and the capital accounts.

2) Therefore, the discount rate policy, under the assumed circumstances, may bear no proper meaning.

reserves for domestic credit.

What is known from the above is that the effect of monetary policy under fixed exchange rates depends crucially on a) the portfolio adjustment speed and b) on the controllability of foreign capital flows. To the extent that the portfolio adjustment of the private sector is slow, the increase in highpowered money will temporarily increase the domestic money supply; to the extent also that foreign capital flows may be controlled, the domestic and foreign money markets are separated in such a way that domestic monetary policy is not undermined by capital flows.

3. Policy to curb capital flows

As will be developed below, the difficulty encountered by Germany during the period of our study was mainly the problem of capital flows, which tend to offset the effectiveness of monetary policy. Theoretically speaking, there are basically two ways to solve this problem: either to prohibit completely the international mobility of securities or to adopt freely fluctuating exchange rates. If neither of these is possible, a third way is to find a policy tool, other than monetary, that can be independently used for the purpose of regulating the economy.

These possible solutions to the problem of capital flows will be discussed below, beginning with an analysis of policies implemented by the German authorities. The second possibility, exchange rate policy, will be discussed in section 4. The policy mix solution will be dealt with econometrically in the next chapter.

(a) External convertibility

The external convertibility of the German mark was reestablished in December 1958 at the same time as the

other major currencies of the OEEC countries. In the case of Germany, the convertibility was nearly perfect in that no external transactions, either current account or capital, were in principle subject to direct control by the government. Therefore, the policy to curb foreign capital flows in Germany was always one of indirect intervention into the foreign exchange market by making use of some price mechanism. Notably, a discriminatory use of the reserve requirement policy between residents and nonresidents, supplemented by repeated recourse to the forward swap policy deserve our attention.

(b) Reserve requirement policy to nonresidents' deposits

Until about 1967, an asymmetry was observed between the use of the reserve requirement policy towards residents and nonresidents. First, the required reserve ratio for nonresidents' deposits was always set higher than that for residents' deposits. Secondly, the reserve requirement ratio for residents' deposits tended to decrease (with some exceptions), while that for nonresidents' deposits showed a cyclical pattern. Needless to say, such an asymmetry was introduced by the authorities with the intention of curbing the inflow of foreign capital.

Between 1967 and 1971 this asymmetry disappeared. The same requirement was applied to both residents and nonresidents' deposits. However, the authorities did not abandon their attempts to separate the domestic and foreign money market, which is evidenced by the more vigorous use of the marginal reserve requirement policy since 1968. According to this policy, a certain reserve ratio is required to maintain with respect to the increase in the nonresident deposits from a fixed level. Throughout most of 1969 this ratio was as high as 100%, while the reserve requirement for residents' deposits during the same period was about 10%. After 1971, the marginal reserve requirement

fluctuated between 30 and 60%.

The asymmetric use of the reserve requirement policy intended to separate the domestic and foreign money markets. If the reserve requirement ratio applied to nonresidents' deposits is higher than that for residents the interest rate that German banks may offer foreigners would be, *ceteris paribus*, lower than that offered to residents. From the standpoint of foreigners who want to hold their assets in German banks (in the form of German marks), the interest rate applied to their deposits becomes lower, thus discouraging capital inflows to Germany.

There are some limits to the effectiveness of such a measure. If a foreign parent company has a German branch to which it makes remittances, the branch may convert the remittance into marks which may then be deposited as resident deposits in Germany. In such a case the special reserve requirement policy has no effect in preventing foreign funds from flowing into Germany.

Another point to notice is that the interest rate reducing effect of a higher reserve requirement ratio (either average or marginal) should be compared with current exchange rate expectations. If there is already a firm exchange rate expectation, and if the expected change is sufficiently large, funds will flow toward the currency which is expected to appreciate. This is especially true in the case of exchange rate changes under the adjustable peg which is said to allow a "one way option" for speculators when an exchange rate change is expected.

A third point to notice is, given that international capital flows reflect the portfolio adjustment of residents and nonresidents, a change in the interest rate induced by a once-and-for-all change in the reserve requirement ratio does not impose a lasting impact on capital flows. Capital would flow in or out during a certain period of time at the end of which, when the residents and nonresidents are both satisfied with their respective financial holdings, no further flows would occur. In order to bring about

lasting effects on capital flows, the reserve requirement ratio must be changed continuously.

(c) Swap policy

Since 1958 the Bundesbank has occasionally offered a possibility for private banks to engage in a swap contract with the central bank. Under this scheme, the Bundesbank sells US dollars to private banks with a repurchase agreement that is due in 3 to 6 months. At the issue of the swap contract, the Bundesbank repurchases the dollar at a rate which is more favorable for banks than the market rate. Thus the private banks are induced to hold dollars rather than marks.

As suggested by the fact that the scheme was introduced in 1958, the initial objective of the swap policy was to promote external capital flows by inducing private banks to hold foreign currencies. It soon became apparent, however, that external capital flows were prevalent enough, so that the main objective of the central bank was then directed at preventing the official foreign reserves from increasing too rapidly. Thus, substantial swap contracts were engaged in on particular occasions, as in 1967 (after the bearish speculation on the British Pound in November), in 1968 (after the May Crisis in France), and in 1969 (preceeding the revaluation of the German mark in October).

Analytically speaking, swap policy is a simultaneous spot forward contract. When the contract is engaged, the Bundesbank sells the spot dollar in exchange for the spot mark, while at the same time buying the forward dollar in exchange for the forward mark. In order to induce the private banks to cooperate with the Bundesbank, the authorities must offer terms that are at least as good as those offered in the market. Otherwise private banks would prefer the mark over the dollar and the swap would not occur. This amounts to nothing more than giving a subsidy

to banks in return for their holding dollars. Moreover, if the mark is revalued during the span of the contract, the authorities must eventually buy the depreciated dollar in exchange for the appreciated mark. This, in a way, means that the authorities cooperate with the speculative activities of the banks.

Another point to note about the forward swap policy is its somewhat ironical aspect: the forward swap policy (originally intended to reduce the official holdings of foreign reserves) might stimulate the private sector's borrowing abroad, and cause further inflow of capital. Suppose the forward dollar is at par in the market, and that the Bundesbank offers forward premium to the commercial banks holding the dollar. If interest rates are the same in Germany and the United States, the German banks may profit by importing the dollar which they sell spot at the market exchange rate and repurchase forward at the market rate. At the same time they sell the spot mark (which they obtained from selling the spot dollar) to the Bundesbank and buy the spot dollar, they buy the forward mark in exchange for the forward dollar at the favorable terms offered by the Bundesbank. The private banks thus cancel spot dollar sales by the spot dollar purchases, and forward dollar purchases (at the market rate) by forward dollar sales (vis-a-vis the authorities). The outcome, needless to say, is a profit resulting from the two different prices of the forward dollar. Although the authorities could curb such further inflows of capital, it is clear that the use of the forward swap is somehow limited.

4. Exchange rate policy and speculation

With respect to the foreign exchange policy of the German authorities, we can distinguish two phases between 1960 and 1973. During the first phase, the authorities

were eager to maintain a fixed parity of the German mark and, to some extent, they succeeded. This phase covered the period from 1960 until around 1971.

During the second phase, the authorities gradually acknowledged, although not necessarily willingly, the necessity of permitting flexibility in the exchange rate. The reason for the change in their attitude was, of course, repeated international monetary crisis accompanied by huge capital flows. During the second phase, however, the authorities were not at all willing to adopt freely flexible exchange rates. Far from that, the basic attitude of the authorities was still in favor of a fixed parity for the exchange rate, as shown by the fact that the occasional floats during this phase were mostly of the "dirty" variety.¹⁾ Thus we may characterize the first phase as the fixed exchange rate period while the second one as the quasi-fixed, or the quasi-floating, period.

As will be developed later (section 6), the exchange rate changes in Germany, throughout these periods, were mostly motivated by huge speculative capital flows that made it impossible for the authorities to maintain a fixed parity. These exchange rate changes occurred under a fixed exchange rate system or, more appropriately, under an adjustable peg system. Some discussion will be helpful to see the relationship between the adjustable peg system and speculation.

It is widely accepted that if a number of different monetary authorities pursue different monetary policies, some exchange rate adjustment among their currencies should occur in the long run. This is especially the case if each monetary authority regards economic growth as well as full employment as the main economic policy goals, and if

1) The term "dirty" seems to connote some value judgment. As an analytical term, a "dirty" float is quite misleading. It may involve any intervention by the authorities to stabilize the foreign exchange market.

a downward rigidity of prices and wages exists.

Under the adjustable peg system, the "fundamental" disequilibrium in the balance of payments must in principle be corrected by exchange rate changes, while "non-fundamental" disequilibrium must be corrected by such measures as the use of foreign reserves, IMF drawings, fiscal and monetary policies and so on. The fact that the adjustable peg system--or, more appropriately, the Bretton-Woods system--regards exchange rate changes as a special, rather than normal, way of adjusting disequilibrium of international payments suggests that the founders of the IMF expected that disequilibrated international payments would develop mainly because of current account (or more precisely trade account) transactions. Such disequilibria, they apparently thought, could be adjusted by exchange rate changes that directly affect exports and imports.

Such a system could be expected to work reasonably well as long as capital account transactions are considered to be of relatively minor importance. Actually, however, the development of international capital markets and the increased mobility of capital across country borders has gradually undermined the basic philosophy on which the Bretton Woods system was based.

The development of international capital markets has made it possible for holders of financial assets to shift their assets from one country to another within a very short time at relatively minor charges. This means that whenever an exchange rate adjustment is expected there is an implicit possibility that large capital flows out of a weaker currency to a stronger currency will occur.

In this connection, it should be noted that the international capital flows referred to above mainly concern international portfolio reshuffling--not the "flow" type of capital movements which are motivated by the differences between the expenditures and income of a given country.

With respect to the portfolio reshuffling type of international capital flows, it may be said that they are

a phenomenon principally observed under a fixed exchange rate regime. The reason is very simple: given an exogenous impact that gives rise to portfolio reshuffling, what kind of adjustment is possible for the private sector? The "price" adjustment, i.e., changes in the exchange rate is an excluded possibility; changes in the interest rate may also be excluded if this country is small. The type of portfolio adjustment available for the private sector is limited to the category of "quantity" adjustment, i.e., export or import of capital.

In contrast, flexibility of exchange rates gives rise to a possibility that the portfolio adjustment may be carried out by "price" adjustment. Given the exogenous impact, the initial disturbance may be partly or totally absorbed by exchange rate changes, possibly without any actual capital flows. In this particular sense, a flexible exchange rate regime could work as a system that tends to restrict international capital flows: what used to be "traded" securities under fixed exchange rates tends to become "nontraded" under flexible exchange rates.

It has been shown by repeated experience¹⁾ that the adjustable peg system is unable to cope with the increased possibility of international capital flows. This is fundamentally because the adjustable peg system is basically a fixed exchange rates that tend to increase the 'tradability' of securities internationally, and in particular because exchange rate adjustment under the adjustable peg is generally regarded as a last resort; the authorities tend to wait until the final moment, when the necessity for a rate change has become all too conspicuous. Using the facilities of the efficient international capital market, speculators²⁾ are free to speculate on whichever

1) Some of the experience of speculative capital flows under the adjustable peg system will be presented in 6.

2) When speaking of "speculators", one has to distinguish at least two types. The first relates (to the next page)

currency is expected to revalue, thereby aggravating the situation. Further, their speculative activities can never lose, because it is generally true that if a currency is about to undergo an exchange rate change under the adjustable peg, it is very easy to predict in which direction (devaluation or revaluation) it will move. Thus the speculators either win or draw, but they never lose.

The exchange rate policy in Germany, reflecting these shortcomings of the adjustable peg system, was motivated mostly by speculative capital flows. Needless to say, these flows did not occur independently of more fundamental forces: the monetary and fiscal policies of the authorities, real growth of the economy, technological development of German enterprises, and so forth. However, one may reasonably say that exchange rate adjustments were not directly motivated by these factors. The adjustment was more directly motivated by huge capital flows that disrupted the foreign exchange market--so much so that the authorities had no other option but to change the exchange rate. In this sense, the German authorities typically showed the type of behavior expected of authorities under the adjustable peg system.

5. Fiscal policy

In comparison to monetary policy, fiscal policy is doomed to be an unwieldy policy tool. In some respects, the ability of fiscal authorities to react to policy target

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- 2) (Continued) to what is called leads and lags related to traders' activities and the second to professional speculators. Given, however, that both base their actions on the difference between the current forward and the expected future spot rate, they belong to the same category of speculators as defined by Tsiang Shu, Chieh, "The Theory of Forward Exchange and Effects of Government Intervention on the Forward Exchange Market", IMF Staff Papers, Apr. 1956.

variables is restricted. First, even if the necessity for a policy action is recognized quickly, the fiscal authorities may not be able to pursue the necessary action immediately. Their budget must first go through a screening by parliament, resulting in a lag in policy responses.

Secondly, and this is especially true for a federalist country like Germany, the role of local governments may be fairly active. If this is true, the central fiscal authorities' policy actions may be undermined by local governments that do not necessarily follow the line of the central authorities.

These practical shortcomings of fiscal policy should not be exaggerated, however, because in some respects the policy does respond rapidly to policy targets. A notable example is the built-in stabilizer function of fiscal policy. The progressive income tax system, unemployment benefits and so on work quite rapidly in response to such target variables as excess demand in the goods and services market and the unemployment rate. In comparison to monetary policy, the reaction of the fiscal authorities is more rapid in this case, since some time would be necessary to alert the monetary authorities to the need for action. Such a recognition lag is not needed as far as the built-in stabilizer is concerned.

Another point to note about fiscal policy is that as long as it affects directly the goods and services market as a component of the total demand, the lag between policy action and policy effect can be expected to be relatively short. This is an important difference between fiscal policy and monetary policy as a means to regulate the total demand. Since monetary policy effects the behavior of private enterprises only through the interest rate and/or liquidity, its effectiveness crucially depends on how rapidly private enterprise reacts to changes in these variables. If the adjustment speed of private enterprise is very low, or if their sensitivity to interest rates (or liquidity sensitivity) is very low, the effectiveness

of the monetary policy will be very much impaired.

In addition, one should note the effectiveness of fiscal policy in regulating total demand under fixed exchange rates coupled with capital mobility. In contrast to monetary policy, which becomes less efficient if capital is internationally mobile under fixed exchange rates, fiscal policy becomes more effective under the same condition. This is because an increase in government expenditure would tend to raise the interest rate, thereby attracting foreign capital. If the exchange rate is fixed, and if the domestic interest rate cannot be above the foreign interest rate in the long run (the small country assumption) then a balance of payments surplus will develop and the quantity of money will increase through the exchange rate stabilization policies of the authorities. In contrast to monetary expansion policies, whose effectiveness for controlling total demand is undermined by an outflow of capital, the effectiveness of fiscal policy is strengthened by it.

For these reasons, the role of fiscal policy becomes all the more important especially when authorities attempt to regulate total demand without causing too much disequilibria in the balance of international payments. Recognizing this importance, Germany adopted in 1967 a law that ran counter to her traditional federalism. The Stability and Growth Law of 1967 stipulates, among other things, the obligation for local governments to hold countercyclical deposits at the Bundesbank. Further, a business cycle commission, whose members include the federal economic minister and the federal finance minister, is in charge of harmonizing the local governments' fiscal activities. The Bundesbank has a right to participate in the commission.

6. German macroeconomic policy 1960 - 73

Although this study focuses on German macroeconomic

policy formation during 1960 - 1973, it will be useful to start by looking at the period just preceding (five quarters, ending in the third quarter of 1960). This period is characterized by contractionary policies--especially in monetary policy--and is typical of the difficulties encountered in a world of capital mobility. In addition, the policies followed during this period set the pattern for policy formation for the entire period covered by this study.

The reconstruction period after the second world entered a new phase in 1958 with the introduction of a freely convertible currency system. The resumption of free external convertibility meant that all foreign exchange transactions could in principle be carried out without restrictions. Direct government intervention in foreign trade, which had been frequent, gradually disappeared. Moreover, the formation of the European Economic Community integrated the main western European countries (except Britain) into a common market where international trade was to be carried out without tariff barriers. On the financial side, international capital transactions developed markedly after the resumption of the free external convertibility of European currencies. The formation of the Euro-dollar market and its rapid expansion contributed greatly to the increase in international capital mobility.

Against these developments, macroeconomic policy formation had to take international aspects more into account than previously. It was especially important to give appropriate consideration to capital flows and their consequences, if a fixed exchange rate was to be maintained.

(a) 1959/3: contractionary policy

In early 1959, the German economy gradually began to show an overall excess demand in the goods and services market. Industrial production grew 8% during the second

quarter of 1959 (24% annual growth rate), while wages and prices (consumer as well as wholesale price indices) increased with some lags. The quarterly growth rate of wages was about 2.4% in 1959/4, which was about one percent higher than the previous quarter. The consumer price index jumped in 1959/3, while the wholesale price index, showing a slight decline between 1959/1 and 1959/2, started to increase again in 1959/3. The balance of payments had already turned into a net deficit in 1959/1. Although the current balance showed a surplus, the net surplus greatly diminished between 1959/2 and 1959/3.

Facing these developments, the official discount rate of the Bundesbank was raised from 2,75% to 3% in September 1959; and the rate was further increased to 4% (October 1959) and to 5% (June 1960). The Bundesbank credit to the private sector was reduced by roughly 40% during the period 1959/4 until 1961/2.

As soon as the restrictive monetary measures were taken, offsetting capital inflows occurred. Although the net private short term capital account showed deficits between 1959/1 and 1959/3, it had already turned into a considerable surplus by the end of that year, and continued to be so throughout 1960. Reflecting this, the overall balance of 1959/4 showed a surplus of 3.5 bill. marks which could be compared with a deficit of .8 bill. marks in the preceding quarter during which the restrictive monetary measures had been introduced. Capital inflows were quite heavy especially in 1959/4 (1 bill. marks) and 1960/2 (2 bill. marks). In all, the Bundesbank's foreign assets increased by roughly 36% between 1959/3 and 1960/3.

(b) Swap policy and its limitations

With a view to restricting capital inflows, the Bundesbank attempted to use the swap policy in 1960. It extended the policy (which had hitherto been used mainly

to cover exchange risks involved in short-term money market investments abroad) to transactions related to import finances.

The effectiveness of the forward swap policy at that time is said to be doubtful. In competing with the German authorities who offered a premium for dollar holding by commercial banks, some foreign banks (especially Swiss and Italian) were offering better terms to German importers. Moreover, the terms offered by the Bundesbank were not enough to "bring the yield on short-term funds transferred to the US in line with what could be earned in Germany."¹⁾

(c) Revaluation in 1961

The failure of the restrictive monetary policy due to capital flows obliged the authorities to revalue the German mark on March 6, 1961. Its parity was changed from 4.2 marks to 4.0 marks per dollar, or a 5 percent rise in the dollar price of the mark. Although this revaluation was followed by a relatively heavy inflow of foreign capital spurred by the expectation of a further revaluation, the speculative attack on the mark died down by the end of March, due to the firm position taken by the European central banks to avoid further currency adjustment.²⁾

The 1961 revaluation of the mark was followed by a decline in the overall balance of payments surplus in the same year. This trend continued in 1962 until a deficit in the current account was realized. Probably the revaluation itself, in addition to the easier monetary policy

1) Yeager, Leland B., International Monetary Relations, (2nd ed. New York, Harper and Row, 1976) p. 499.

2) The cooperation among the central bankers consisted in a) making short-term loans of needed currencies and b) holding each others' currencies more extensively than before.

that had been implemented earlier,¹⁾ were the main causes of this development in the balance of payments in 1961 - 62.

(d) Reversal to surplus in 1963 and the 1964 boom

The relatively short period of external deficit after the 1961 revaluation had ceased by the end of 1962. In 1963, due to a slow rise in wages and prices, German exports grew steadily. Gold and foreign exchange gains were more than 2 billion marks in 1963, and worries about imported inflation appeared in 1964. The Bundesbank took some measures beginning in early 1964 to curb the inflow of foreign funds. In March the swap policy was revived; interest payments on foreign deposits in German banks were suspended, and the reserve requirement for non-residents' deposits was raised. In addition, the authorities announced their intention²⁾ to introduce a law concerning withholding tax on interest payable to nonresidents on German fixed-interest securities. Although the proposed withholding tax did not come into effect until March 1965, the announcement of it was somewhat effective before the enactment.

Due to these measures and the development of the domestic boom, the overall balance of payments in 1964 was more or less balanced, but turned into a deficit in the following year.

(e) Boom and recession: 1965 - 1967

While the balance of payments showed a balance in 1964, the domestic market tended to show some inflationary

1) The restrictive monetary policy was renounced in November 1960 when the discount rate was reduced to 4%.

2) In March 1964.

features in 1964 - 65. Wages were increasing rapidly in 1964 (8.1% p.a., compared with 5.9% in 1963), and continued to rise, though less rapidly, in 1965. The consumer price index, although relatively stable in 1964 (about a 1% rise), was inflating at about 3% in 1965.

As a result of these developments, a restrictive policy stance was introduced by an increase in the Bundesbanks' discount rate in early 1965. Following that, in October the discount quota to private banks was lowered. The tight money policy was further reinforced by successive increases in the discount rate in August (3.5%→4%) and May 1966 (4%→5%).

The tight monetary policy seems to have been successful this time without causing too much disturbance in the balance of payments. By 1966/2, the inflationary pressure seems to have been suppressed. The reason for this success was mainly the favorable development of foreign interest rates. In fact, these rates happened to rise just as the German authorities were raising the German interest rate, so that capital inflows during the tight monetary policy period were not so annoying to the authorities as they might otherwise have been.

In pursuing the tight monetary policy however, the authorities seem to have gone a bit too far. Apparently their fear of inflationary developments in the price level made them turn from the contractionary to expansionary policy only in late 1966. Nearly all the components of the effective demand had by this time diminished and the next year saw an absolute decline in industrial production.

In response to these developments, the authorities reduced the official discount rate from 5% to 3% during the first half of 1967. The problem of capital flows, quite sensitive to monetary policy, appeared in the opposite way to the 1959 experience. While the inflow of foreign capital had prevented the restrictive monetary policy from working in 1959, the authorities in 1967 had to face a relatively heavy outflow of capital from Germany due to the expansion-

ary policy stance. Because interest rates abroad were generally higher, and because of an increased ability by the nonbanking sector to lend abroad,¹⁾ Germany became a net exporter of long term capital.

(f) Speculations and revaluation in 1968 - 69

Since about 1966 certain European currencies have occasionally been attacked by speculators. Differences in price inflation in Germany, France, England and the United States accumulated to such an extent that the purchasing power principle and the fixity of the exchange rate were no longer compatible. Thus sterling was devalued in November 1967, the French franc devalued and the German mark revalued in 1969.

One major feature of these exchange rate changes is that they were accompanied by huge capital movements. This was particularly the case for Germany which, in spite of all the measures to curb short-term capital movements, faced enormous foreign capital flows on several occasions.

The year 1968 saw surpluses in both trade and current accounts. Although the basic balance of payments was nearly in balance, the official holding of foreign reserves increased by approximately 5 billion marks, the result of a heavy inflow of short-term capital. The general climate of European foreign exchange markets contributed greatly to this situation; the May crisis and the consequent huge outflow of short term capital from France had opened the way for the uneasy months to follow. In November, a generalized expectation on a possible change in the parity of the German mark and the French franc caused a large

1) The Bundesbank's policy to restrict the banking sector's activities by imposing the reserve requirement on foreign deposits and other measures had a side effect of stimulating the nonbanking sector to deal directly with foreigners.

inflow of capital to Germany from France. The main European foreign exchange markets had to be closed for several days in November. Although the mark was not revalued on this occasion,¹⁾ the event was sufficient to convince everyone of the necessity for a currency readjustment in the near future.

The next year, 1969, again witnessed huge capital movements, and on an aggravated scale. In April, another bullish speculation on the mark was motivated by the resignation of French President de Gaulle. In early May, the three-month forward premium of the mark vis-a-vis the dollar neared 9% per annum, while the spot rate exceeded the support ceiling.

The German authorities were reluctant to revalue the mark, mainly for political reasons: a general election was due in September, and the Christian-Democrat government was afraid to launch such a politically risky policy.²⁾

The election in September resulted in the transfer of power from the CDU to the SPD. After a short period of floating, the mark was officially revalued (9.29%), ending the time of speculation.

(g) Restrictive policy 1969 - 1971

As early as April 1969, the official discount rate had been raised from 3% to 4%, and a restrictive monetary policy followed. In early 1970 the discount rate was as high as 7.5%. Although this rate was then successively

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- 1) Instead of revaluating, the German authorities reduced the value-added tax on imports and the tax rebate on exports. Further, the Bundesbank applied a 100% marginal reserve requirement to nonresidents deposits.
 - 2) It is somewhat ironical that this reluctance of the government gave the social-democrats a convenient political target to attack.

reduced, the reserve requirement ratio to residents' deposits was increased between 1970 and 71, leaving the money market rather tight. The authorities probably judged that, despite the revaluation in 1969, wages and prices were rising rapidly enough to justify a tight monetary policy.

As on many other occasions, the authorities were again frustrated by capital flows. Towards the end of 1970, the official holdings of gold and foreign exchange ballooned (5 to 8 billion marks during each of the last three quarters of 1970).

In 1971, the inflow of foreign capital became even more intensive, owing to the private nonbanking sector's borrowing. As it happened, the United States was following an expansionary monetary policy because of the recession there; the crossing of the monetary policies in the United States and in Germany--one expansionary and the other contractionary--stimulated further inflows of funds into Germany. Towards the second quarter of the year, moreover, speculation played an increasingly important role. During the first quarter 1971 the official holdings of gold and foreign exchange increased by about 7 billion marks; since the end of the first quarter 1970, the holdings had increased by roughly 28 billion marks. Thus, by the end of April 1971, the ability of the authorities to maintain the mark's parity had been almost exhausted. In early May, when speculative attacks on the mark became furious, the Frankfurt foreign exchange market was closed; when it was opened later, the authorities gave up their efforts to maintain parity. The mark was floated.

(h) Floating mark 1971 - 73

Between May and December 1971, the German authorities gradually gave up supporting the dollar. After a few weeks of floating, they tried in vain to fix a parity in

June. The premium on the forward mark gradually rose. When the American austerity program was launched by President Nixon in August, the foreign exchange market was again closed. Then, until December, the mark was floating again (as were other currencies), although intervention by the authorities was not excluded.

The Smithsonian agreement in December officially recognized a revaluation of the mark by about 13% (dollar value). With this revaluation however, the German trade balance in 1972 remained in strong surplus (\$6 billion), and gold and foreign exchange gains for the year were about \$15 billion. Although the authorities apparently intended to adopt an expansionary policy, (as shown by successive reductions of the official discount rate (1971) as well as the required reserve ratio (early 1972)) such a policy stance did not last long. In October, the discount rate was raised to 3.5%, while the required reserve ratio had already been increased in July.¹⁾ Despite these rather restrictive policy measures, the price level was rising rapidly in 1972, and continued to do so in 1973. Furthermore, an inflow of capital was again stimulated because of speculative activities.

7. Concluding remarks

From the foregoing discussion of the development of the German economy between 1960 - 73, it is clear that the main problem for the authorities was the conflict between domestic and foreign policy targets--notably the conflict between total demand policy and the balance of payments

1) With foreign exchange gains of 10 billion marks in the second quarter 1972, such a policy formation is really impossible to explain by reference to balance of payments considerations. As shown in the following chapter, the responsiveness of the monetary authorities to foreign reserves was indeed low.

problem under fixed exchange rates. The role played by international capital movements was essential in characterizing the development of the economy.

The conflict between the domestic and foreign targets under fixed exchange rates is a problem that can in principle be solved by an appropriate use of monetary and fiscal policies. In particular, total demand management should be carried out mainly by fiscal policy while the balance of payments adjustment should be carried out mainly by monetary policy. From this point of view, it is useful to study whether the actual German macroeconomic policy was carried out according to the policy assignment prescription. The method to be used for analyzing this problem requires an estimate of the authorities' behavioral equations accompanied by other private sector equations. This is the task of the next chapter.

Chapter 5

A REACTION FUNCTION APPROACH TO GERMAN MACROECONOMIC POLICY, 1960 - 73

1. Introduction

This chapter attempts to analyze the behavior of the German policy authorities between 1960 and 1973 by using the reaction function approach suggested in earlier chapters.

In line with the argument hitherto, a relatively simple macroeconomic model is constructed in section 2 and its properties are briefly discussed in section 3. Although many (perhaps too strong) assumptions are made in its specification, the model still captures some of the essence of the German economy during the sample period summarized in chapter four. Capital exports and imports are specified endogenously as is the balance of payments. These are of course, the three principal variables referred to whenever German macroeconomic policy is discussed.

The fourth section reports the Full Information Maximum Likelihood (FIML) estimates of the model. Despite the extreme simplicity of the model, the estimation results contain some interesting information about German policy formation which reveals the usefulness of our approach. Of particular interest is the fact that German monetary policy, represented by the domestic credit supplied by the Bundesbank, was very insensitive to changes in foreign

reserves (balance of payments). Also of interest is the reason why Germany accumulated foreign reserves so rapidly and encountered occasional balance of payments surplus problems. It seems that the target inflation rate of the authorities was set at too low a level (actually, this rate has been estimated as negative). One implication of the low target inflation rate is that the estimated model shows a dynamically unstable behavior.

The final section makes use of the estimation results for some simulation experiments. In particular, attempts are made to change the values of the reaction coefficients of the authorities. It will be seen that if the target inflation rate had been corrected, and if monetary policy had been more actively used to prevent balance of payments disequilibrium, foreign reserves would have been more stable even if the special measures designed to discourage foreign capital flows (such as the special reserve requirements on nonresidents' deposits in Germany) had not been implemented.

2. Specification of an econometric model

(a) Budget constraints

This subsection deals with the specification of a model of economic stabilization in Germany. For the purpose of presentation, we make use of the following T-accounts (Tables 5-1 and 5-2), where the notation is as follows: P , the price level; e , real expenditure of the non-government public; q , real government expenditure; y , real national income; M , the outstanding stock of high-powered money; FA , the outstanding stock of foreign assets; FL , the outstanding stock of foreign liabilities; C , the central bank's outstanding claims to the private sector (domestic credit); and R , the central bank's holding of foreign assets (mostly foreign exchange). D denotes the differen-

tial operator d/dt , so that DM, DC, etc. represent accumulation or decumulation of the stock variables. It is assumed for simplicity that the government follows a balanced budget policy so that tax liabilities do not explicitly appear in Table 5-2. Foreign debt service is neglected for the same reason.

Central Bank		Private & Government	
C	M	pe	py
R		pg	DC
		DM	DFL
		DFA	

Table 5-1

Table 5-2

Table 5-1 and 5-2 are self-explanatory, except for domestic credit C. In our model, the central bank is assumed to transfer purchasing power DC to the private government sector. Therefore, DC composes a part of the total disposable income $py + DC$. The difference between total disposable income and total absorption ($pe + pg$) effects the accumulation of financial wealth, which is composed of M, FA and FL.

Equating both sides of Tables 5-1 and 5-2 we get:

$$M = C + R \tag{5-1}$$

$$py + DC = pe + pg + DM + DFA - DFL \tag{5-2}$$

The identities (5-1) and (5-2) are the budget constraints of the central bank and of the private sector respectively. Substituting from (5-1) into (5-2), we get:

$$DR = p(y - e - g) - DFA + DFL \tag{5-3}$$

Equation (5-3) shows that the balance of payments, defined as the change in the central bank's foreign assets, is the sum of the balance on current account, $p(y - e - g)$, and the balance on capital account, $(DFA - DFL)$.

(b) Behavioral equations

The expenditure function

The expenditures of the private sector are assumed to depend on two factors. First, private expenditures increase when the level of national income increases. Second, when the actual money stock exceeds the desired stock, expenditures as a proportion of income are increased. Therefore, the expenditure function will take the form:

$$e = f(y, R + D - kpy) \quad (5-4)$$

$$f_1 > 0, f_2 > 0,$$

where f_1 and f_2 denote the partial derivatives. It is to be noted that the second argument of the expenditure function is related to the money stock adjustment function in the following way:

$$DM = \alpha(kpy - (R + D)). \quad (5-4')$$

(5-4') specifies that the accumulation of money is associated with the difference between the demand for high-powered money kpy (k being the reciprocal of the income velocity of high-powered money), and the actual supply. When there is a discrepancy between the two the gap will be adjusted, at the speed α , by finding a vent either in expenditure or in capital flows. Thus, we take the view that the money stock market is not always equilibrated (through changes in the interest rate). Contrary to that, we assume that the money market is normally in a state of

disequilibrium.

Determination of price and income levels

As shown by the specification of the expenditure function, expenditure in the short run--i.e., when there is a discrepancy between the actual and desired money stocks--is a downward sloping function of the price level. Therefore, the aggregate demand for goods and services, composed of private expenditure, government expenditure (g) and the level of foreign demand (x) is also a downward sloping function of the price level.

On the supply side, we assume that producers are maximizing profits by equating the real wage rate with the marginal product of labor. The production function is postulated to take the form:

$$y = f(N) e^{\lambda_5 t} \quad (5-5)$$

where N denotes employed labor and λ_5 the percentage rate of technological development. Profit maximization then implies that

$$\frac{p}{w} e^{\lambda_5 t} = \frac{1}{f'(N)} \quad (5-6)$$

which is essentially the labor demand function. If we further assume that the supply of labor is perfectly elastic at the current level of nominal wages, treated as exogenous, we may use (5-5) and (5-6) to eliminate N . The reduced form production function thus derived is:

$$y = y\left(\frac{p}{w} e^{\lambda_5 t}\right) \quad y' > 0 \quad (5-7)$$

The equilibrium condition of the goods and services market is given by:

$$y + im(y) = e + g + x \quad (5-8)$$

where $im(y)$ represents the level of imports as a function of national income. Solving equation (5-8) explicitly in terms of y we get:

$$y = h(e + g + x) \quad h' > 0 \quad (5-8')$$

Equations (5-7) and (5-8') determine simultaneously the level of income and the price level.

Capital flow equations

In specifying the capital flow equations we make use of the partial adjustment hypothesis. Let FA be the level of foreign assets held by domestic residents. We then assume that FA is adjusted so that changes in the level of FA during a given period of time reflects the discrepancy between the desired level of FA and its actual level:

$$DFA = \beta(FA^* - FA) \quad (5-9)$$

where β denote the speed of adjustment.

In estimating the model, various variables are used as explanatory variables of the desired level of FA . First following the standard portfolio selection theory, the domestic interest rate (r) and the foreign interest rate, adjusted for forward premium, (r^*) are used. In addition, the level of exports is used as an additional explanatory variable, on the assumption that traders (exporters) want to hold a certain amount of foreign assets (and liabilities) when they engage in foreign trade. Although the level of trade (exports + imports) rather than exports only is perhaps a better explanatory variable, this choice was avoided because the level of imports is endogenous (see (5-8) above) and the use of the level of trade in the capital flow equation would have introduced a complication. Another explanatory variable is the level of wealth. When the level of wealth is relatively high, the demand for foreign assets (as well as domestic assets) will also be

high. Therefore it is desirable to have a wealth variable as one of the explanatory variables. Data on wealth not being available, the level of national income is used as a proxy for it.

The last explanatory variable for the desired level of FA is related to the money stock adjustment. As noted above, any discrepancy between the actual and the desired level of the money stock will find a vent either in expenditure or in capital flows. Thus, when the money market is in disequilibrium, the desired level of FA will be altered. When the money market is in equilibrium, the desired level of FA is explained only by wealth and interest rates (and the level of trade).

Combining these considerations, we get:

$$FA = FA(r, r^*, x, y, R + D - kpy) \quad (5-10)$$

$$FA_1 < 0, FA_2 > 0, FA_3 > 0, FA_4 > 0, FA_5 > 0$$

The signs of the partial derivatives are self-explanatory.

Exactly the same sort of arguments appear, *mutatis mutandis*, in the capital inflow function. Let FL denote the level of foreign liabilities and we have:

$$DFL = r(FL(\dots) - FL) \quad (5-11)$$

$$FL = FL(r, r^*, x, y, R + D - kpy) \quad (5-12)$$

$$FL_1 > 0, FL_2 < 0, FL_3 > 0, FL_4 > 0, FL_5 < 0$$

Reaction functions

There are two reaction functions of the authorities: one is the fiscal authorities' reaction function and the other the monetary authorities' reaction function.

With respect to former we specify that the change in government expenditure is determined as a function of (a) the actual price level relative to the target price level;

(b) the actual level of foreign reserves relative to the target level; and (c) the actual national income level relative to the target level of national income. In other words, the authorities have a certain target level for each target variable and if there is any difference between the target level of the target variable and its actual level, they will take action to reduce the difference.¹⁾

Specifically, this hypothesis results in the following specification of the fiscal reaction function

$$Dg = f(p - p^*, R - R^*, y - y^*) \quad (5-13)$$

$$f_1 < 0, f_2 > 0, f_3 < 0,$$

where the starred variables denote the target level of the target variables. In actual estimation of the model, the target level of the target variables is assumed to be growing at a constant rate.

By the same token the reaction function of the monetary authorities is specified as:

$$DC = f(p - p^*, R - R^*, y - y^*) \quad (5-14)$$

$$f_1 > 0, f_2 > 0, f_3 > 0.$$

It is further assumed that the target level of each target variable is the same for both monetary and fiscal authorities.

(c) The full model

Equations (5-3), (5-4), (5-7), (5-8), (5-9), (5-11),

1) For the interpretation of the target level of target variables, see below, especially section 4 of this chapter.

(5-13) and (5-14) taken together constitute a system of eight equations that simultaneously determine the following variables: p , y , e , R , FA , FL , g and C . The equation below shows the model composed of these eight equations in loglinear form.

$$\text{Dlog } g = -\Pi_1 \log P + \Pi_2 \log R - \Pi_3 \log y + (\Pi_1 \lambda_1 - \Pi_2 \lambda_2 + \Pi_3 \lambda_3) t \quad (5-15)$$

$$\text{Dlog } C = -\Pi_4 \log P + \Pi_5 \log R - \Pi_6 \log y + (\Pi_4 \lambda_1 - \Pi_5 \lambda_2 + \Pi_6 \lambda_3) t \quad (5-16)$$

$$\begin{aligned} \text{Dlog } R + \lambda_2 \log R - \left(\frac{P^* y^*}{R^*} - \frac{P^* e^*}{R^*} + \frac{P^* g^*}{R^*} \right) \log P - \frac{P^* y^*}{R^*} \log y \\ + \frac{P^* e^*}{R^*} \log e + \frac{P^* g^*}{R^*} \log g - \lambda_2 \frac{FL^*}{P^*} \log FL + \lambda_2 \frac{FA^*}{R^*} \log FA - \\ - \frac{FL^*}{R^*} \text{Dlog } FL + \frac{FA^*}{R^*} \text{Dlog } FA + \text{constant} = 0 \quad (5-17)^1) \end{aligned}$$

$$\text{Dlog } FA = \Pi_7 (-\Pi_9 \log r - \Pi_9 \log r^* + \Pi_{10} \log x + \Pi_{11} \log y + \Pi_{12} (\log (R + C) - \log kpy) - \log FA) \quad (5-18)$$

$$\text{Dlog } FL = \Pi_8 (\Pi_9 \log r - \Pi_9 \log r^* + \Pi_{10} \log x + \Pi_{11} \log y - \Pi_{12} (\log (R + C) - \log kpy) - \log FL) \quad (5-19)$$

$$\log e = \Pi_{13} \log y + \Pi_{14} (\log (R + C) - \log kpy) \quad (5-20)$$

$$\log y = \Pi_{15} \log (e + g + x) \quad (5-21)$$

$$\log p = \Pi_{16} \log y + \lambda_5 t + \log w \quad (5-22)$$

1) (5-17) is obtained by loglinearizing the following relationship around the steady state growth rate (λ_2) of foreign reserves:

$$DR = p(y - e - g) + DFL - DFA$$

The starred variables in (5-17) are the initial values of the corresponding variable. A brief description of how the loglinearization is carried out is given in Appendix 2.

Before turning to the estimation results some comments on the full model are in order. First, it is not possible to identify all the target growth rates λ_1 , λ_2 and λ_3 . This is because equations (5-15) and (5-16) give only two bits of information (as the estimated coefficient of the time variable in these equations) with regard to the three unknowns λ_1 through λ_3 . For the sake of identification, some restrictions among these target rates are necessary.

Suppose the actual growth rate of the target variables coincides with the target rates respectively; suppose further that the private sector is in stock equilibrium in the money market. From these two conditions--which will be achieved in the long run if the model is stable--it is possible to derive the necessary restrictions on the relationship between the λ 's.

From the first condition it must be true that

$$\text{Dlog } p = \lambda_1 \quad (5-23)$$

$$\text{Dlog } R = \lambda_2 \quad (5-24)$$

$$\text{Dlog } y = \lambda_3 \quad (5-25)$$

On the other hand, the second condition implies that

$$\frac{R + C}{kpy} = 1 \quad (5-26)$$

If we further assume that R and C should grow at the same rate (λ_2) so that the composition of high-powered money does not change in the steady state, it must be true from (5-26) that:

$$\text{Dlog } R + (1 - \alpha) \text{Dlog } C = \text{Dlog } P + \text{Dlog } y \quad (0 < \alpha < 1)$$

or

$$\alpha \lambda_2 + (1 - \alpha) \lambda_2 = \lambda_1 + \lambda_3 \quad (5-27)$$

where $\alpha/1 - \alpha$ is the long run value of R/C . If we solve (5-27) simultaneously with

$$\Pi_1 \lambda_1 - \Pi_2 \lambda_2 + \Pi_3 \lambda_3 = \hat{\mu}_1$$

$$\Pi_4 \lambda_1 - \Pi_5 \lambda_2 + \Pi_6 \lambda_3 = \hat{\mu}_2 \quad (5-28)$$

where $\hat{\mu}_1$ and $\hat{\mu}_2$ denote respectively the parameter estimates of the left hand expressions of these two equations, we may deduce λ_1 , λ_2 and λ_3 . What is implied by these restrictions on the λ 's are that the authorities aim for a fixed ratio between high-powered money and nominal national income in the long run. Within these restrictions, the authorities choose certain values for the target inflation and income growth rates and hence, implicitly, the target reserve growth rate. Whether or not the target rates are realized, however, depends on the dynamic behavior of the model as a whole, and eventually on the stability of the model. If the model is unstable, the target growth rates will never be attained.

The model assumes that the corresponding behavioral coefficients of the capital outflow equation and of the capital inflow equations ($\Pi_9 - \Pi_{12}$) are the same,¹⁾ so that the only difference between these equations is the speed of adjustment (Π_7 and Π_8). It is further assumed that the elasticity of desired asset (liability) holding with respect to the domestic interest rate and with respect to the foreign interest rate (adjusted for forward premium) are the same in absolute value. This, in turn, is based on the assumption that the market engages in covered arbitrage by comparing the relative magnitude of accruals from investing in foreign and domestic assets.

Finally, some rather special characteristics of the

1) Paying due consideration to signs: All the parameters (Π 's) are defined as positive.

model should be noted. While it would have been possible to find a more satisfying specification than the one proposed, it would have been at the expense of the model's simplicity. It was, therefore, decided to maintain the current specification and concentrate on the analysis of the policy reaction functions. However, in future works some of the following characteristics of the model could be modified.

We first note that the money stock is defined as high-powered money and the money demand function is defined with respect to it. This is done in order to avoid introducing a private banking sector while at the same time being able to define monetary policy in terms of domestic credit which is the control variable of the authorities. Next, the domestic interest rate is treated exogenously, and interpreted as the price variable for German liabilities abroad (FL). The foreign interest rate, in turn, is interpreted as the price variable for foreign assets (FA). Both interest rates however are determined in the world market independently of the German market. Thirdly, a balanced budget policy is assumed for simplicity so that there is no public debt. Finally, the model does not contain any expectation variables. This is probably one of the main shortcomings of the model, because the exclusion of expectations (with respect to the price level and wages) allows no room for a Philips curve-type relationship between employment and inflation. Again, these restrictions seemed necessary to limit the model to a manageable size and to concentrate on the reaction functions.

3. Working of the model and its estimation

(a) Working of the model

The behavior of the model is affected by the authorities in two ways: first, by the reaction coefficients

(Π_1 through Π_6) and second, by the value of the target growth rates of the target variables (λ 's).

With respect to the reaction coefficients, we would expect that the monetary and fiscal policies would be contractionary if the actual price level (the income level) exceeds its target level, and vice versa. Likewise we would expect that they would be contractionary if the actual level of foreign reserves falls short of its target level.

Turning to the impact of policy variables on the rest of the economy, we note that monetary policy has a direct effect on three behavioral equations, expenditure and the two capital flows. Suppose domestic credit has been increased thus creating, for the moment, a discrepancy between the desired and the actual money stocks. The excess supply of money could be spent on goods, on purchasing additional foreign securities, or on redeeming foreign borrowings. All of these reactions have direct effects on the balance of payments. In addition, there are indirect effects. The increase in expenditure due to monetary expansion implies that the demand for goods and services (e) increases; hence an upward pressure on the price level. The higher price level now stimulates producers to employ more labor; hence a higher national income.

Fiscal policy has direct effects on the income determination equation and the balance of payments equation. An increase in government expenditure increases national income, and it also increases the total absorption relative to total income. Indirectly, it gives rise to an excess demand for money stock because of the increased income (and the price level). Notice in this context that the monetary consequences of monetary and fiscal policies are opposite: while an expansionary monetary policy creates an excess supply of money, an expansionary fiscal policy creates excess demand.

(b) Results

The estimated structural model is given below. A FIML estimation procedure was used, and the figures under each parameter estimate indicate standard errors.¹⁾

$$\begin{aligned} \text{Dlog } q = & \underset{(.089)}{-.198 \log \left(\frac{p}{e^{\lambda_1 t}} \right)} + \underset{(.021)}{.067 \log \left(\frac{R}{e^{\lambda_2 t}} \right)} - \underset{(.23)}{.46 \log \left(\frac{y}{e^{\lambda_3 t}} \right)} + \\ & + 1.81 \\ & (.95) \end{aligned} \quad (5-29)$$

$$\begin{aligned} \text{Dlog } C = & \underset{(.27)}{-.67 \log \left(\frac{p}{e^{\lambda_1 t}} \right)} + \underset{(.063)}{.015 \log \left(\frac{R}{e^{\lambda_2 t}} \right)} - \underset{(.64)}{2.00 \log \left(\frac{y}{e^{\lambda_3 t}} \right)} + \\ & + 8.64 \\ & (2.69) \end{aligned} \quad (5-30)$$

$$\begin{aligned} \text{Dlog } R + \lambda_2 \log R - 3.53 \log p_y + 2.92 \log p_e + .56 \log p_g - \\ \lambda_2 .32 \log FL - .32 \text{ Dlog } FL + \lambda_2 .26 \log FA + .26 \text{ Dlog } FA - \\ - 1.14 = 0 \\ (.20) \end{aligned} \quad (5-31)$$

$$\begin{aligned} \text{Dlog } FA = & \underset{(.08)}{.24} \left(\underset{(.22)}{-.47 \log r} + \underset{(.22)}{.47 \log r^*} + \underset{(.14)}{1.50 \log x} + \right. \\ & + \underset{(.14)}{1.50 \log y} + \underset{(.42)}{.91 \log \frac{R+C}{kpy}} - \log FA \left. \right) - 1.81 \\ & (.239) \end{aligned} \quad (5-32)$$

1) A computer program, RESIMUL, written by C. Wymer of the London School of Economics, was used. Programs written by the same author (CONTINEST and PREDIC) were used to calculate eigenvalues and to carry out simulations of the estimated model.

$$\begin{aligned} \text{Dlog FL} = & .11 \text{ (.47log r - .47log r* + 1.50log x +} \\ & \text{(.05) (.22) (.22) (.14)} \\ & + 1.50\text{log y - .91log } \frac{R+C}{\text{kpy}} - \text{log FL) - 1.38} \\ & \text{(.14) (.42) (.50) (5-33)} \end{aligned}$$

$$\begin{aligned} \text{log e} = & .86\text{log y} + .04\text{log} \left(\frac{R+C}{\text{kpy}} \right) + .55 \\ & \text{(.01) (.01) (.08) (5-34)} \end{aligned}$$

$$\begin{aligned} \text{log y} = & .98 \text{ (.68log e + .13log g + .18log x) + .75} \\ & \text{(.01) (.05) (5-35)} \end{aligned}$$

$$\begin{aligned} \text{log p} = & .24\text{log y} + \text{log w} - .013 \text{ t} - .87 \\ & \text{(.11) (.013) (.50) (5-36)} \end{aligned}$$

$$\begin{aligned} \lambda_1 = & -.062 & \lambda_3 = & .036 \\ & \text{(.016)} & & \text{(.015)} \end{aligned}$$

4. Analysis of the behavioral equations

(a) The reaction functions

All of the estimated coefficients of the fiscal policy reaction function have signs corresponding to a priori expectations; fiscal policy will be contractionary if either the price level or the income level exceeds the target level, and vice versa. When the level of foreign reserves exceeds its target level, an expansionary fiscal policy will be followed. The significance level of each reaction coefficient is reasonably high.

With respect to monetary policy, the sign pattern of each and every reaction coefficient is the same as that for fiscal policy, although one of the estimated coefficients (monetary reaction to the level of foreign reserves) is quite insignificant (the t-value is only .24).

It is interesting to consider the extent to which each

policy variable is given importance in determining the actual behavior of the authorities. The absolute value of the estimated coefficient is insufficient for this purpose because it depends on the unit of measurement of the explanatory variable. A more appropriate measure is to calculate beta-coefficients, obtained by multiplying the absolute value of the estimated coefficient by the ratio of the standard deviation of the explanatory variable to the standard deviation of the explained variable.

Table 5-3 shows the beta-coefficients as calculated (they are standardized to add up to 100).

	<u>Fiscal</u>	<u>Monetary</u>
Price level	21	21
Foreign reserves	18	1
National income	61	78

Table 5-3

Monetary policy's apparent neglect of the level of foreign reserves as a target variable is striking, especially if we also note that the reaction coefficient of monetary policy to foreign reserves is not significantly different from zero. It is apparent that no systematic policy actions have been taken in order to offset variations in the level of foreign reserves.

Looking at the other reaction coefficients, both monetary and fiscal policies have been conducted with relatively more emphasis attached to the national income target than to other targets. However, there is a clear difference between monetary and fiscal policy. In the case of fiscal policy, the importance of the price target and that of the foreign reserve target is more or less the same--the former being slightly more important than the latter. In the case of monetary policy, the importance of the foreign reserve target is quite negligible. Thus, monetary policy can be said to have been assigned relatively

more to the national income target, while fiscal policy was assigned relatively more to the price target and/or the foreign reserve target.

(b) Target growth rates

The growth rates of the price level (λ_1), income level (λ_3) and the target level of foreign reserves (λ_2) were estimated with the restriction:

$$\lambda_2 = \lambda_1 + \lambda_3 \quad (5-27)$$

According to the estimation result, the target growth rate of the price level is about -6% and that of the income level, 3.5% quarterly. The significance level of these estimates is reasonably high, the t-values being 3.90 and 2.45 respectively.

It might appear strange that the target inflation rate is estimated to be negative. Intuitively at least, one would think that the target inflation rate should be positive, especially if one believes that the government will accept a Philips curve-type relationship according to which some (positive) inflation must be paid in order to maintain a high level of employment. Further, if a government wants to fix the foreign exchange rate, it must also allow foreign inflation to be transmitted to the domestic economy through goods arbitrage and/or balance of payments adjustments. It seems quite difficult to reconcile these points with the negative estimate of the target inflation rate.

The key to a solution is to consider the meaning of the target rates. It is by no means necessary that these target rates be actually "set" by the authorities with their full intentions. Instead they could be interpreted as objective measures of the authorities' actual policy. What can be claimed from the evidence is that the German

authorities acted as if they had intentionally set the target inflation rate very low and negative. (That they intentionally aimed at such a target is a claim that cannot be convincingly substantiated.)¹⁾ The bitter experience of hyperinflation after the first and the second world wars no doubt contributed to such an attitude towards their policy formation. Another important reason, as Michaelly points out,²⁾ is that the authorities seemed to regard the accumulation of foreign reserves as desirable, since Germany had a relatively low level of foreign reserves at the beginning of the post-war period. Maintenance of a lower price level relative to other countries would, under fixed exchange rates, normally stimulate exports and reduce imports, thus making possible a reasonably rapid accumulation of foreign reserves.

As we will see later, an important consequence of the negative estimate of the target inflation rate is that the model becomes unstable. This means, in the present context, that Germany has had a latent tendency to accumulate foreign reserves much more rapidly than actually experienced. However, the special measures which were introduced to decrease the balance of payments surplus, such as special reserve requirements on non-residents' deposits, restrictions on interest payments to foreigners, and so on prevented this tendency from materializing. The revaluations of the Mark also contributed to keeping down the

1) Thus, if the estimate is taken at face value, the German authorities followed an extremely restrictive policy with a 24% price deflation per year in mind, only to obtain a 3 to 4% inflation (average inflation rate during the sample period) in reality. Considering that the German inflation rate has not been significantly different from the world inflation rate, the evidence might suggest how strongly inflation rates among different countries tend to converge under fixed exchange rates.

2) Michaelly, Michael, Responsiveness of Demand Policies to Balance of Payments, Columbia Univ. Press, 1971) p.138

balance of payments surplus.

(c) Capital flow functions

Capital flow functions were estimated separately with respect to capital inflow and capital outflow. All the estimated coefficients have the expected signs, and they are reasonably significant (the t-values of the estimated coefficients range from 2.12 to 10.47). Of particular interest is the fact that the estimates show capital flows to be significantly associated with disequilibria in the money market. When, for instance, the monetary authorities increase domestic credit, there will be ceteris paribus a stock excess supply of money which will cause either an increase in expenditure and/or an increase (decrease) in foreign asset (liability) holdings. Since the estimated elasticity of the desired level of foreign assets and liabilities with respect to a money market disequilibrium is approximately 0.9 and the elasticity of expenditure with respect to a money market disequilibrium is 0.04, the importance of capital flows in considering the effectiveness of monetary policy is readily recognized. Although a one percent increase in the money supply, holding other things constant, increases expenditure by only 0.04 percent during the current quarter, the same increase in the money supply brings about a .2 percent increase (the elasticity of the desired foreign assets holding with respect to the money market disequilibrium multiplied by the speed of adjustment) in capital outflows.¹⁾

The capital flow equations are also explained by the domestic and foreign interest rates and by the level of

1) A crude calculation suggests that a DM one billion increase in domestic credit will result in a DM one hundred million decrease in foreign reserves in the current quarter. Out of the DM one hundred million reserve loss, three quarters are due to net (to the next page)

exports as a proxy for the level of trade. The estimated elasticity of the desired foreign assets with respect to the level of exports is about 1.50, while the elasticity with respect to the interest rate (domestic as well as foreign) is about .46.

(d) The income function and the price function

These functions were estimated with expected signs. The elasticity of output with respect to aggregate demand ($e + g + x$) is estimated to be .98 and this estimate is highly significant.

Equation (5-36), which was derived as the reduced form production function, was estimated satisfactorily. The coefficient on the time variable of this equation, which is the rate of technological development,¹⁾ was estimated to

-
- 1) (Continued) capital outflows and a quarter to the current balance. (These figures are calculated by using only the capital flow equations (5-32) and (5-33), and the expenditure and income functions (5-34) and (5-35). A more desirable way to calculate them is to attempt a simulation. However, this was not done because of the instability of the estimated model. Although the reserve loss thus calculated seems to be too low (only 10% of the initial increase in the money supply is offset by the reserve loss during the current period), this seems to be caused by the fact that only the recorded foreign assets and liabilities were used as data for FA and FL while the so-called errors and omissions--reported only on a net basis--were not used. Porter (in Porter, Michael, "Capital Flows as an Offset to Monetary Policy: The German Experience, "IMF Staff Papers, 1972, pp. 295 - 424) has the same problem: when he excluded errors and omissions from the explained variable in his capital flow equation, the estimate of the "offset coefficient"--which roughly corresponds to the speed of adjustment in our capital flow equation--was very low and insignificant. When they were included, the offset coefficient was larger and highly significant.
 - 2) Given that (5-36) does not contain any variable that represents capital equipment, the coefficient on the time variable of this equation may be regarded as reflecting both technological (to the next page)

be roughly 5.2% per annum.

5. Stability analysis and simulation

(a) Stability analysis

The purpose of this section is to analyze the dynamic behavior of the estimated model and to consider ways in which that behavior can be improved by modifications in policy. We will first compare the stability of the estimated model with a version that excludes the policy reactions of the authorities.

Table 5-4 and 5-5 show the eigenvalues of the model. Table 5-4 refers to the case where the reactions of the authorities are included (the reaction coefficients are assumed to take the estimated values): there are only five eigenvalues because the model includes three relationships that are instantaneously determined (notice that e , y , and p appear in the model without any lags). When we exclude the authorities' reactions, we have only three eigenvalues because the two policy variables will then appear without any lags.

<u>Eigenvalues including the authorities' reactions</u>	<u>Eigenvalues excluding the authorities' reactions</u>
-.2608	+.2381
-.0771	-.2886
-.1833	-.1286
$+.1583 + i(.0111 + 2n\pi)$	

Table 5-4

Table 5-5

In both cases, the system is stable if and only if the real part of all the eigenvalues is negative.

2) (Continued) developments and growth of capital.

In comparing Table 5-4 with Table 5-5 we note the following: first, the behavior of the model, whether or not the authorities' reaction coefficients are included, is unstable since one of the eigenvalues is in both cases positive (in the case of Table 5-4, there is a pair of complex eigenvalues whose real part is positive); second, although the inclusion of the policy authorities does not completely stabilize the dynamic behavior of the model, it does reduce the value of the largest eigenvalue,¹⁾ and in this sense it would be possible to say that the authorities have succeeded in increasing the stability of the whole economy; thirdly, the inclusion of the authorities introduces a cyclical behavior which does not exist in the case where no endogenous policy reactions are assumed.

The reason the model is unstable, given the result of the estimation, is as follows. First, we notice that the estimation results suggest that the authorities' policy reactions were such that only a decreasing level of foreign reserves was consistent with their target values for price and income levels (λ_1 and λ_3). Actually, however, these target values, (especially the price target) were not achieved. In fact Germany experienced a moderate inflation and a relatively rapid income growth, both of which contributed to a steady increase in the public's money demand. Although such a development was unsatisfactory to the authorities (who therefore tended to be reluctant to increase domestic credit and government expenditure), the private sector was able to satisfy their money demand by running a balance of payments surplus. However, such a development in the balance of payments did not effect the authorities' policy formations, as indicated by the fact that their policy was aimed chiefly at domestic targets. The more the authorities tried to influence domestic targets, the larger the consequences on foreign reserves.

1) When the authorities are excluded, the largest eigenvalue (real part) is .2388; when they are included, it is .1583.

Therefore, the actual behavior of reserves was contrary to what the authorities had in mind.

Even though they could not achieve it, the fact that the German authorities acted as if they wanted a declining price level (and declining foreign reserves) contributed to the large accumulation of reserves. The authorities' policy objectives were, in other words, constantly undermined by the economic forces governing a fixed exchange rate system.

Thus if we take our estimates at face value, we might be able to guess that the behavior of the model (especially that of foreign reserves) would have been more stable if the target inflation rate had been more realistic. In what follows we will try to confirm this point by some simulation exercises. We will also try to suggest ways in which reaction coefficients can be changed so as to obtain a better performance.¹⁾

(b) Forecast by the estimated model

Let us first examine the forecast ability of the estimated model.

Figures 5-1 to 5-8 show the results of single period forecasts of the model during the sample period: for each period the exogenous as well as the lagged endogenous variables are treated as fixed, and the values of the

1) In the text, I have avoided using the term "model excluding the authorities" for the case where all the reaction coefficients are set equal to zero. This is because the (loglinear) balance of payments equation is affected by the authorities' setting of target growth rates. Thus, even if the reaction coefficients are set at zero, the remaining model may not properly be termed as the model excluding the authorities. It is still meaningful to compare the stability of the two systems in order to know the effectiveness of the authorities' reactions independently of the target growth rates.

current endogenous variables are calculated. Although the estimated model explains the overall behavior of the endogenous variables reasonably well, there are some problems involved. It is quite evident that the phase of the predicted values shifts from that of the actual values by roughly one quarter for the variables g , C , R , FA and FL . For the variables e , y and p the phase shift is less obvious, although the behavioral equations of these variables, as well as those of the five variables above, have strongly autocorrelated residual terms.

This phase shift is probably due to some error in specifying the dynamics of the model. The exclusion of expectation variables in capital flow equations as well as in reaction functions might have caused this problem. Although it would be desirable to develop a model that takes account of these factors, for the moment, we will use the estimated model for the simulation exercises.

(c) Simulation experiment: improvement of policy performance

The forecast in the preceding subsection treats the lagged endogenous variables of the estimated model as exogenous. Since the estimated model is dynamically unstable, a simulation experiment that treats the lagged endogenous variables as endogenous will necessarily generate an exploding path for each variable: hence the necessity for special policy measures such as creation of artificial international interest differentials, devaluation and revaluation, import or export restrictions and so forth.

If we change the value of the parameters of the estimated model in such a way that the modified model is dynamically stable, we may attempt a simulation experiment that treats the lagged endogenous variables as endogenous and may compare its result with the observed value of each

endogenous variable.

One way to stabilize the estimated model has already been mentioned above. First, the target growth rates must be changed. Secondly, the authorities' reaction coefficients could be changed. In the simulation experiment, the target inflation rate is set as 3.024% per annum and the target income growth rate is set as 4.876% per annum. These are the average rates of growth of each variable between 1960/1 and 1969/4. The reason why the sample period (1960-73) average was not chosen for the target rate is that the period after 1970/1 should be treated as a somewhat extraordinary period during which the devaluation of the dollar, the generalized floating of the main currencies, worldwide inflation and many other well-known disturbances occurred almost simultaneously.

Figures 5-9 to 5-13 show the result of a simulation experiment. In this simulation, the monetary policy reaction to the balance of payments target is set to be .2 while that with respect to the income target is set to be 1.5. Further, the monetary policy reaction to the price target is set to be .2. Comparing the beta-coefficients implied by these settings of the reaction coefficients with those of monetary policy of the estimated model, we obtain Tab. 5-6.

	Estimated Monetary Policy	Simulated Monetary Policy
Price level	21	20
Foreign reserves	1	16
National income	78	64

Table 5-6

As revealed by Tab. 5-6, the importance of the foreign reserves target relative to both the price level and national income targets are greatly increased in this simulation. The largest eigenvalue of the simulated system is now -.001 so the system is stable and the

simulation is attempted. The result shows that a rapid expansion of domestic credit and a relatively contractionary fiscal policy would have been followed. With respect to foreign reserves, it is shown that the overall accumulation of foreign reserves during the sample period would have been less than the actual, while the accumulation of foreign reserves during earlier quarters (till 1969) would have been faster than actually occurred. Taking into account the fact that the simulated path of the balance of capital accounts shows less surplus than the actual path (see Figures 5-12 and 5-13), the accumulation of foreign reserves in the simulation is due mainly to the current balance surplus which has been caused by the relatively contractionary fiscal policy. Notice that in spite of the relatively contractionary fiscal policy, the overall accumulation of foreign reserves is less than the actual path, implying that monetary policy under the simulation was expansionary enough to offset the current account surplus by a capital account deficit. An inspection of Figure 5-10, comparing the actual path of the domestic credit with the simulated path, immediately reveals that monetary policy would have been highly expansionary under the simulation.

The result of the simulation suggests that fiscal policy could have been used more extensively in order to obtain more reasonable behavior of the balance of payments. In Figures 5-14 to 5-16, such attempts are made. In these simulations the fiscal policy reaction coefficients are changed in addition to the monetary reaction coefficients. In particular, the fiscal policy reaction to the price target is set at .7, to the balance of payments at .1, and to the income level at .5. Table 5-7 compares such a setting of the fiscal reaction coefficient with that of the estimated model in terms of the beta-coefficients.

	Estimated fiscal policy	Simulated fiscal policy
Price level	21	45
Foreign reserves	18	15
National income	61	40

Table 5-7

In addition to these changes in fiscal policy, another assumption is made with respect to the growth rate of fiscal expenditure. As has been shown above, the reaction coefficients as well as the target growth rates, taken together, determine the coefficient of the fiscal reaction function with respect to the time variable. Under the assumed reaction coefficients of the fiscal policy, this coefficient (growth rate of the fiscal expenditure) is about 4% per year. Attempts are made to increase the value of this growth rate independently of the reaction coefficients and the target growth rates. Two such attempts are made, one assuming a 4.4% growth rate and another, 4.8%. This in fact amounts to assuming an independent factor that contributes to the growth of the fiscal policy.

The results of the simulations are shown in Figures 5-15 to 5-17. The path indicated by dots corresponds to the case where the coefficient of the fiscal policy with respect to the time variable is 4.8%; the path indicated by plus, 4.4%; and the path indicated by minus, 4%. As will be seen, the more expansive the fiscal policy, (along with the fact that it is used relatively more to the domestic target) the less will be the burden on monetary policy, and the less will be the accumulation of foreign exchange.

One interesting question that could be asked at this stage concerns the stability of the growth rate of foreign reserves. One would expect this growth rate to be relatively stable in order for the public's expectations about the future course of the exchange rate to be stable. Thus, independent of the difference in the absolute value of the

growth rate of foreign reserves, it would be meaningful to compare the standard deviations of the actual and the simulated paths. It is calculated that the standard deviation of foreign reserves as observed is .08, while that of the simulated path (for the case where the fiscal growth rate is 4.4%) is .02. This indicates that under the simulated path the opportunity for a destabilizing speculation due to the public expectations might have been less than under the observed path. A better assignment of policy tools to targets would probably have resulted in a more desirable behavior of the foreign reserves.

Conclusion

In this chapter we have analyzed the structure of German macroeconomic policy formation and examined its effectiveness as a means of stabilizing the behavior of the German economy. We have found that German economic policy has to some extent been successful in stabilizing the economy, but not entirely; and that the reason why the estimated model is unstable is due mainly to the low inflation target "set" by the authorities.

Furthermore, we have found that in order to dampen fluctuations in the foreign reserves, monetary policy should have been focused more on the balance of payments target. The simulation experiments have shown that in this case monetary policy would have been quite expansionary. It would then be desirable to make more extensive use of fiscal policy. Thus the result of the simulation experiments shows the importance of the appropriate use of monetary and fiscal policies in controlling the behavior of an open economy with high capital mobility.



Figure 5-2

----- domestic credit (observed)
 ——— domestic credit, single period forecast

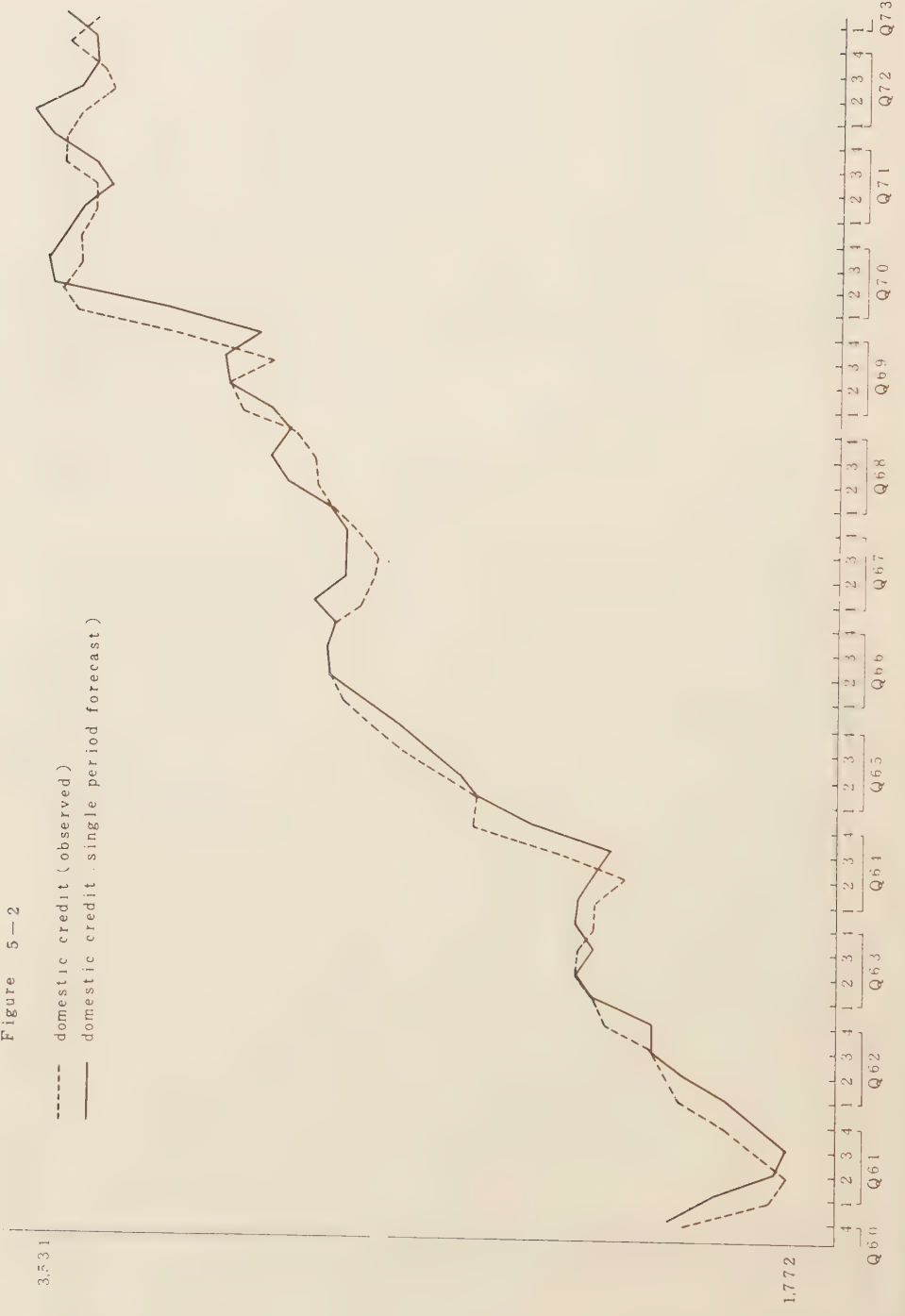


Figure 5-3

Foreign reserves
 ----- observed
 ——— single period forecast

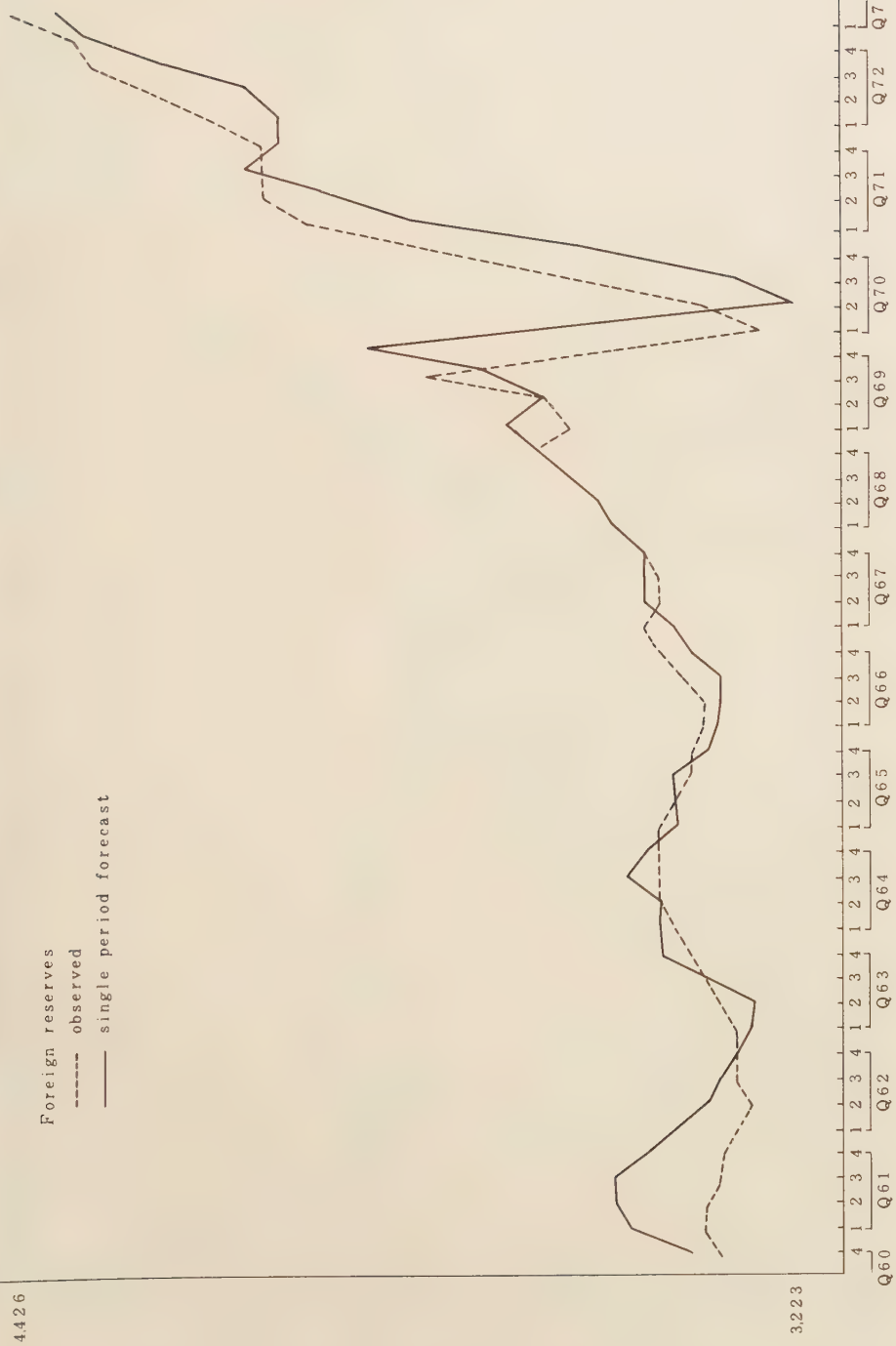


Figure 5-4

Foreign Assets
 ----- observed
 ——— single period forecast

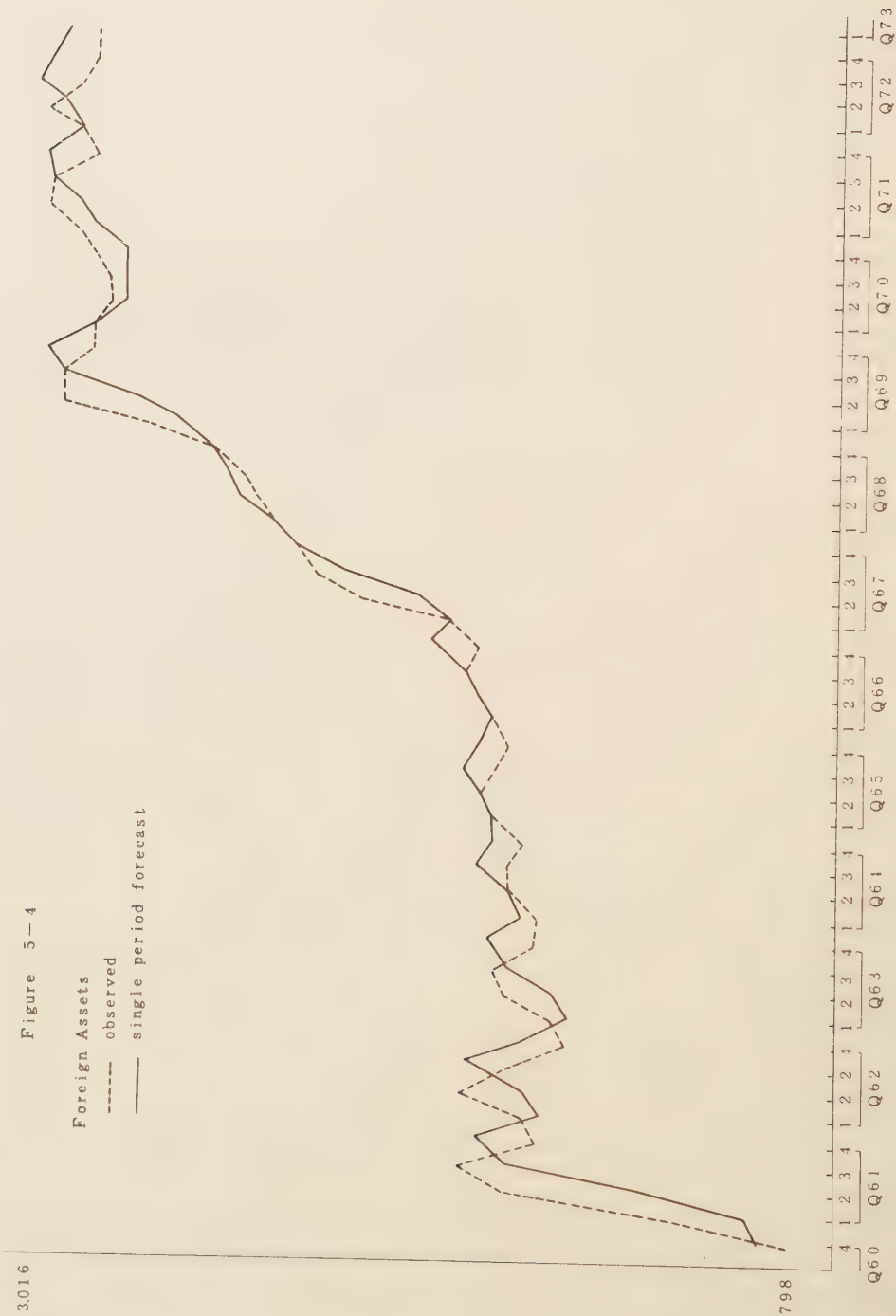


Figure 5-5

Foreign liabilities

----- observed

—— single period forecast



Figure 5-6

Expenditure
 ----- observed
 ----- forecast

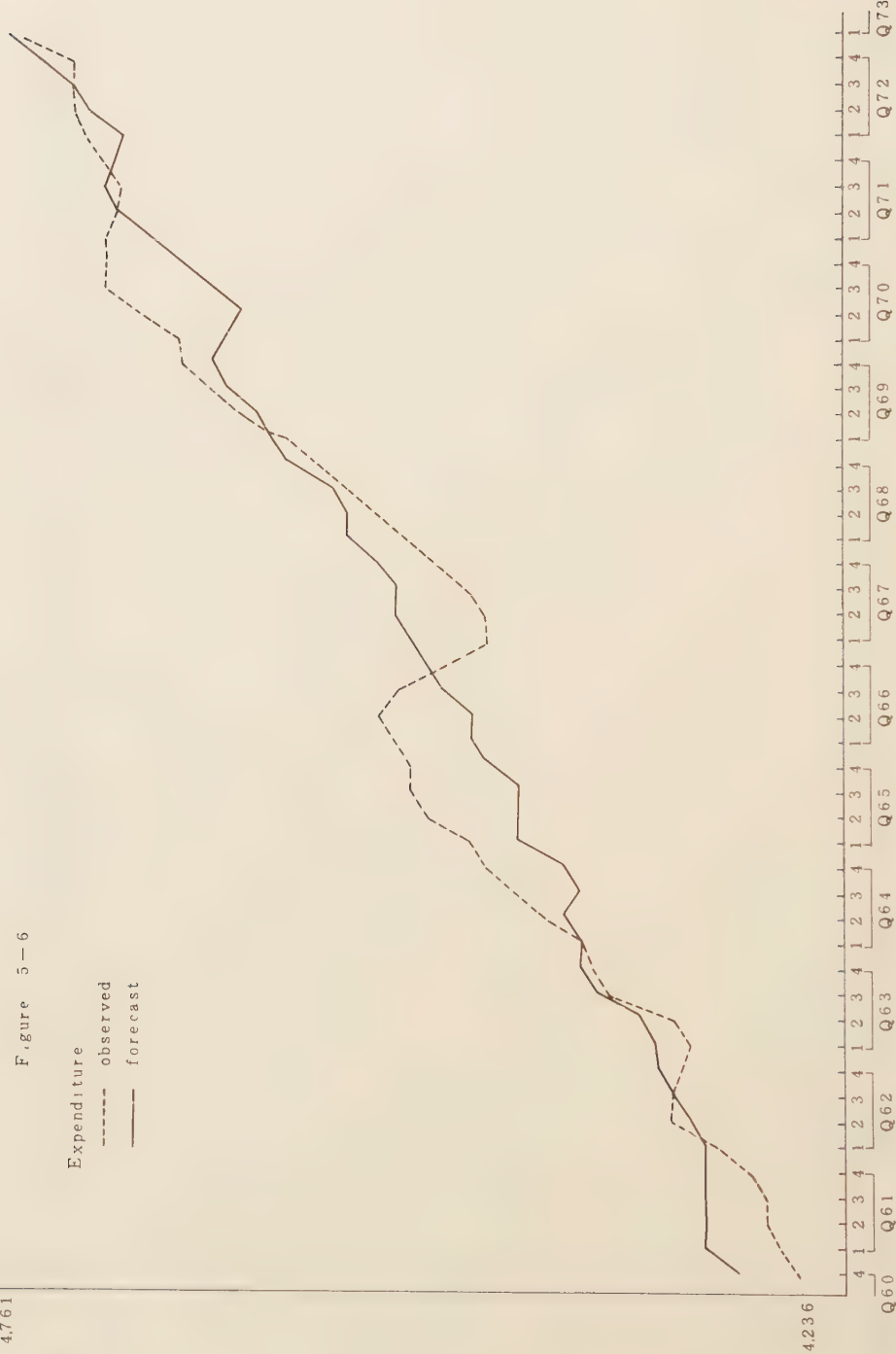


Figure 5-7

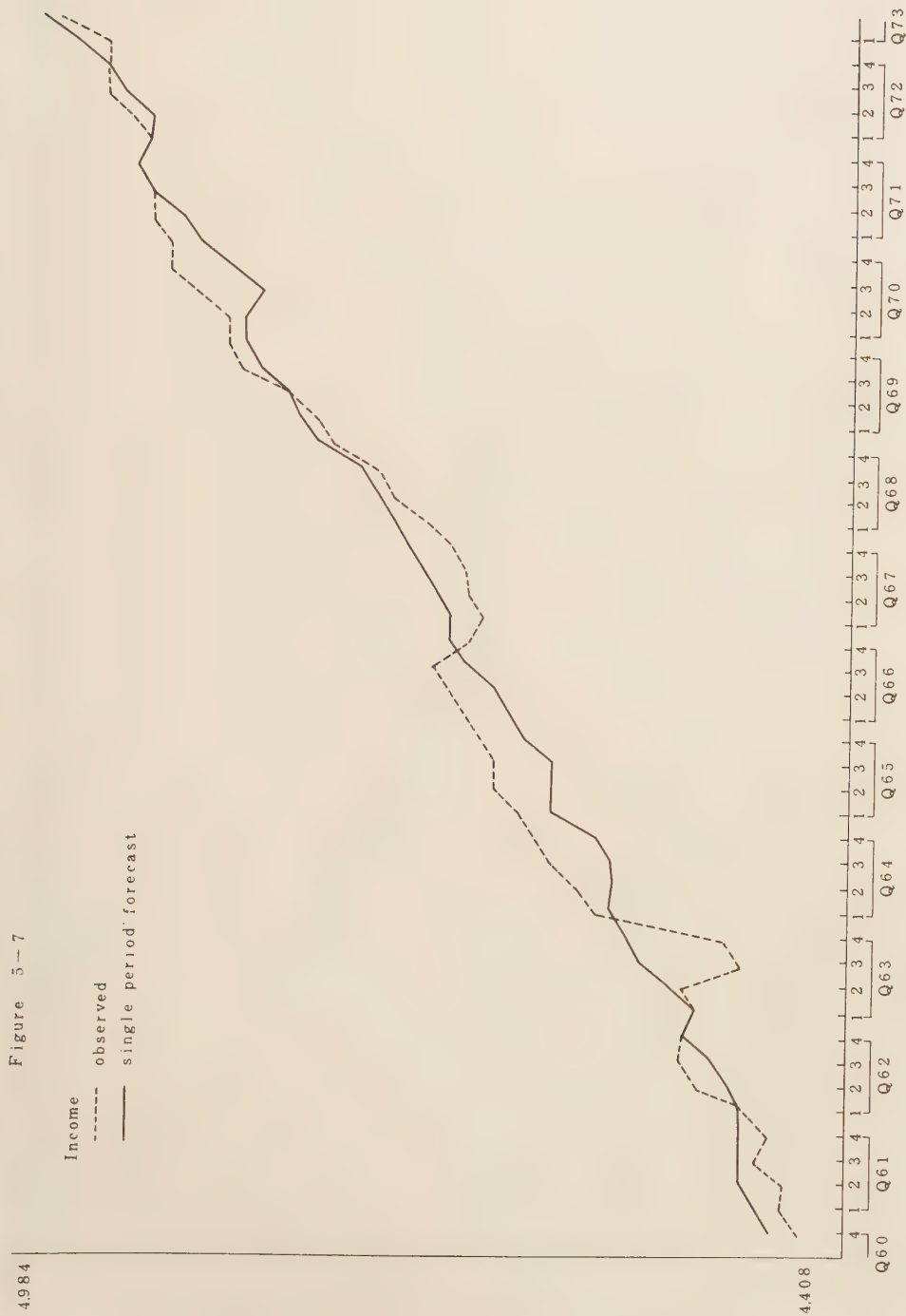


Figure 5-8



Figure 5 - 9

Government expenditure

----- observed

— monetary policy corrected

3264

2271

Q 60 Q 61 Q 62 Q 63 Q 64 Q 65 Q 66 Q 67 Q 68 Q 69 Q 70 Q 71 Q 72 Q 73

Figure 5-10

Domestic credit
 ----- observed
 ----- monetary policy corrected

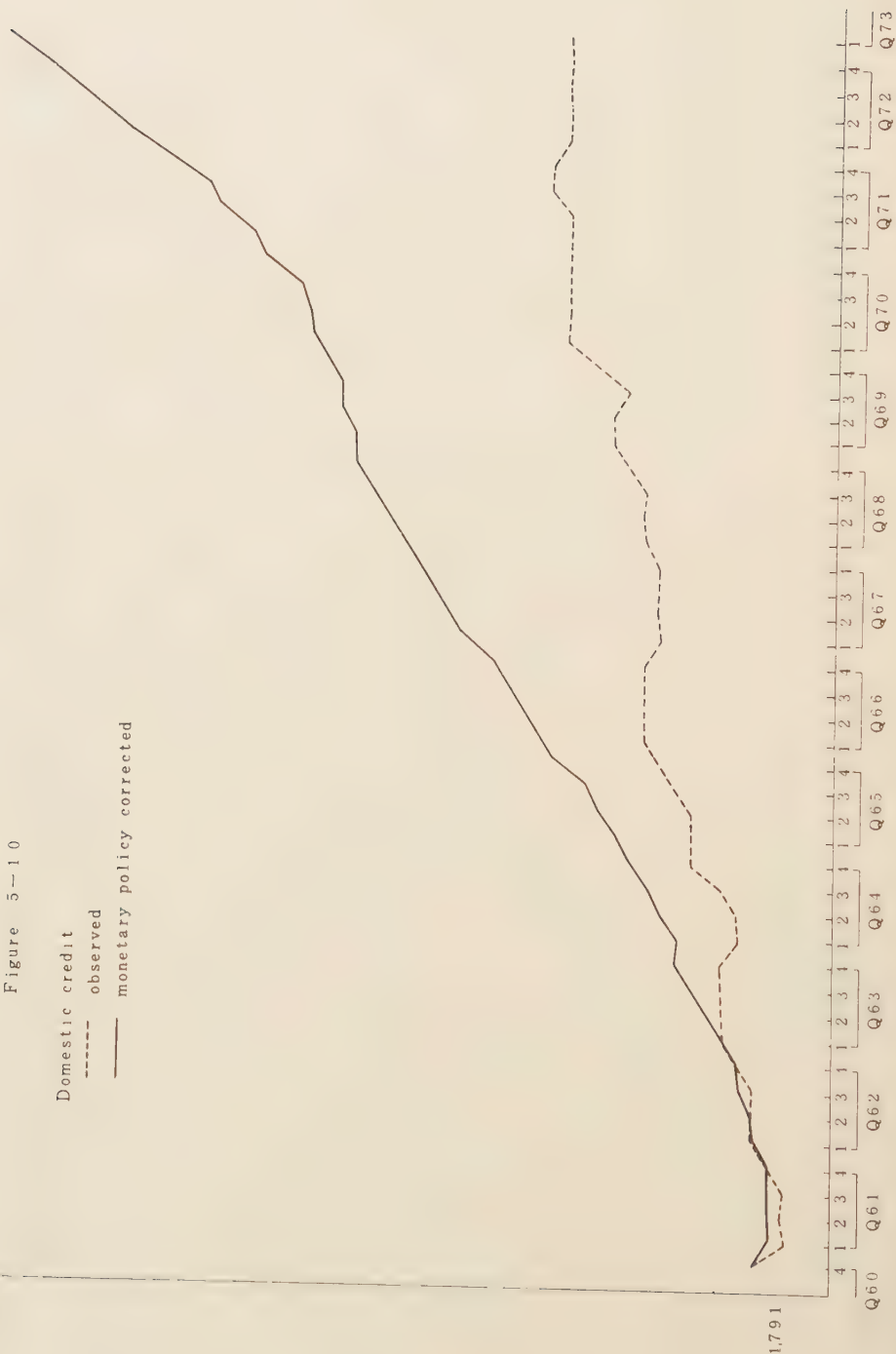


Figure 5 11

Foreign reserves
 ----- observes
 ——— monetary policy corrected

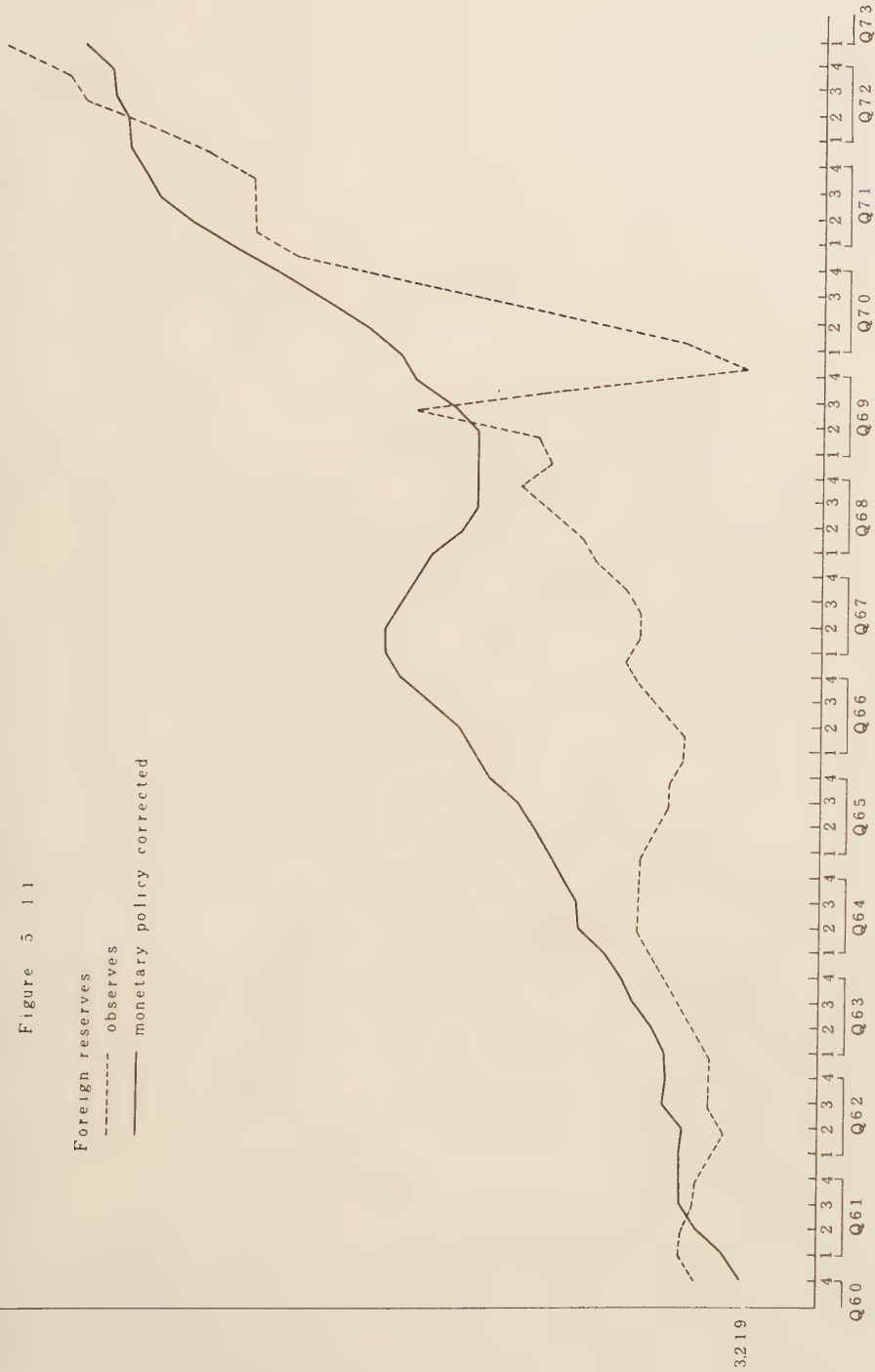


Figure 5 12

Foreign assets

----- observed

— simulated

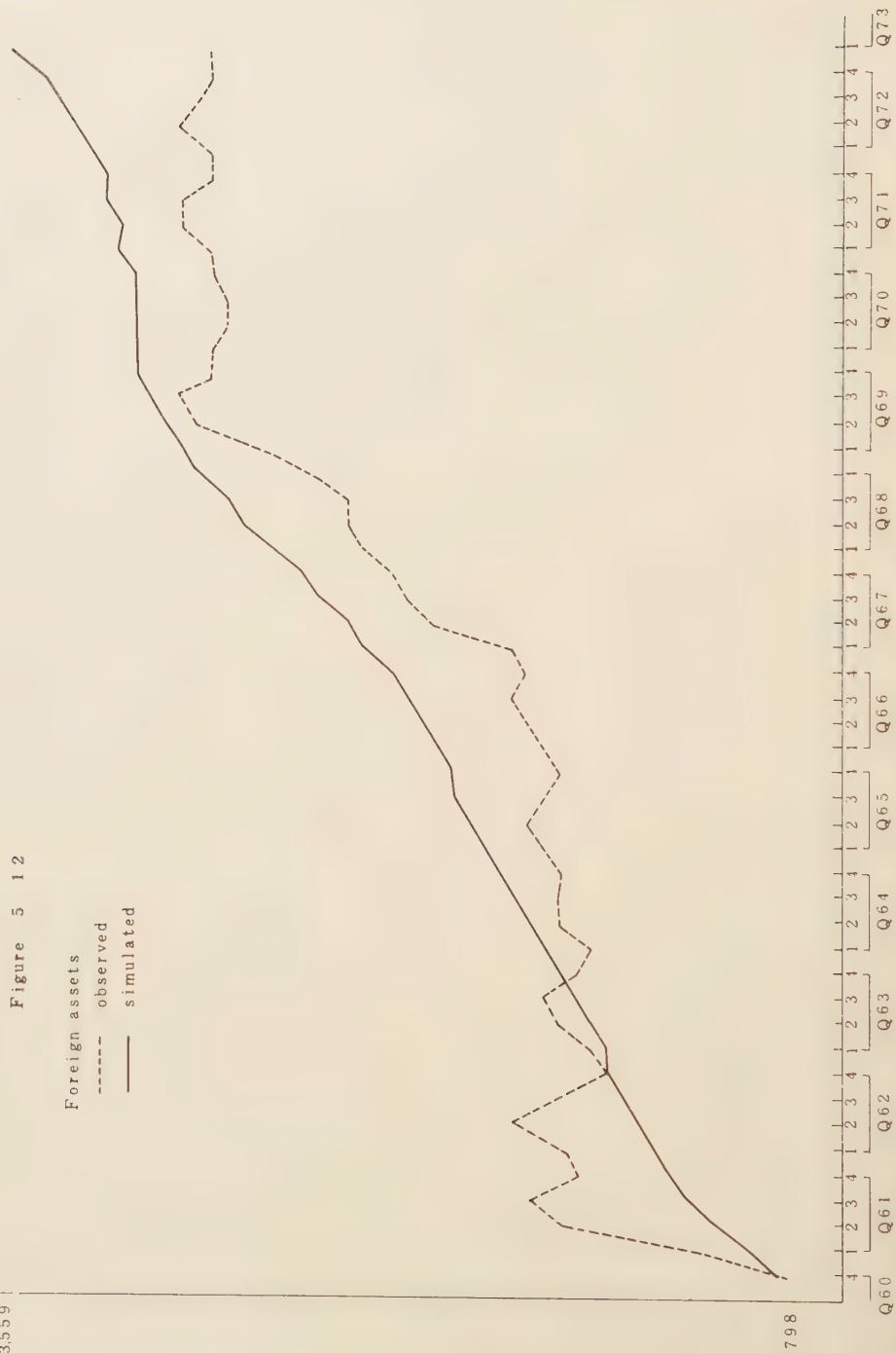


Figure 5-13

Foreign liabilities

----- observed

— simulated

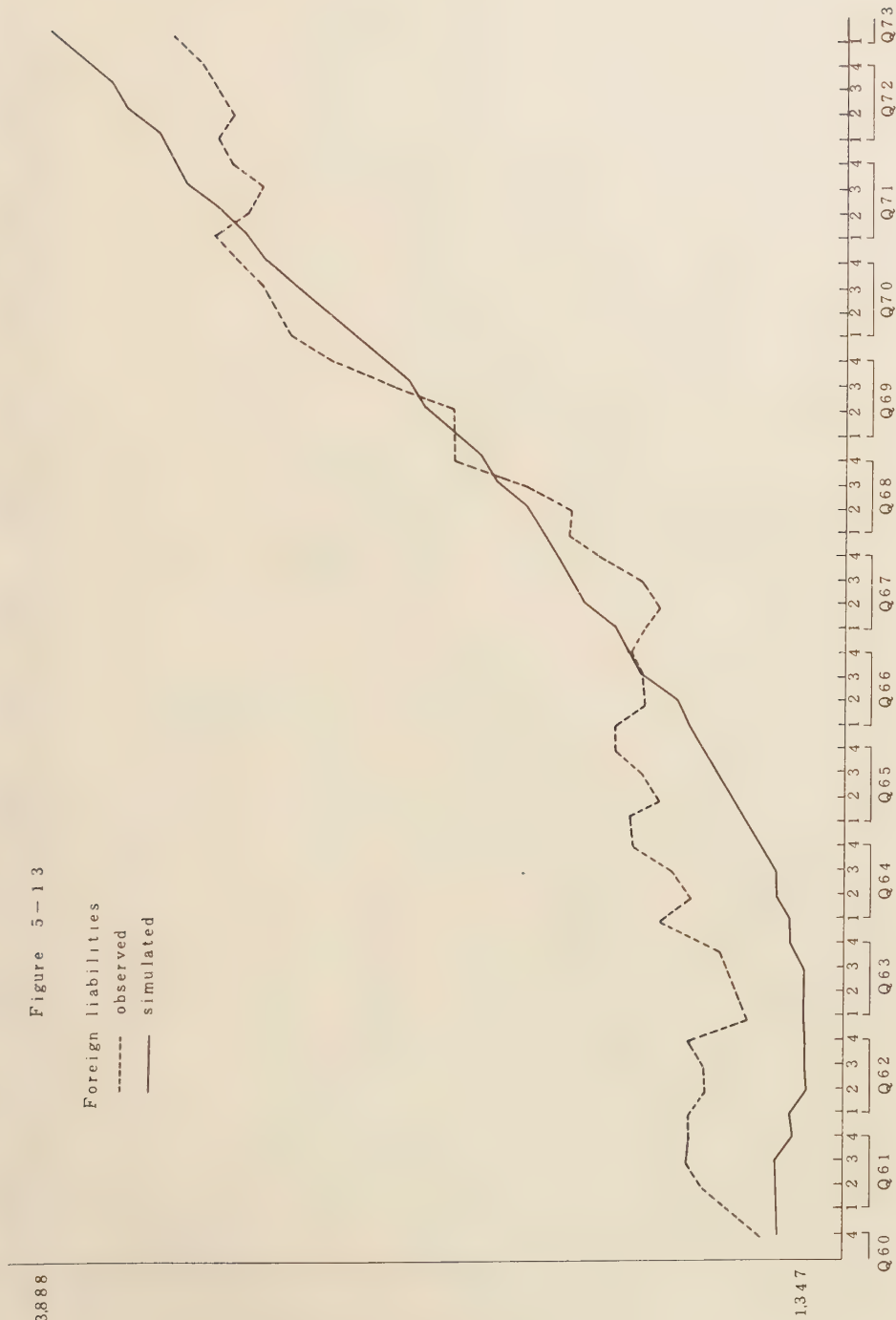


Figure 5-14

----- observed government
 expenditure 4.8 %
 ----- 4.4 %
 ----- both policies corrected 4.0 %



Figure 5-15

----- observed domestic credit
 1.8% fiscal growth
 1.4%
 4.0%
 --- both policies corrected

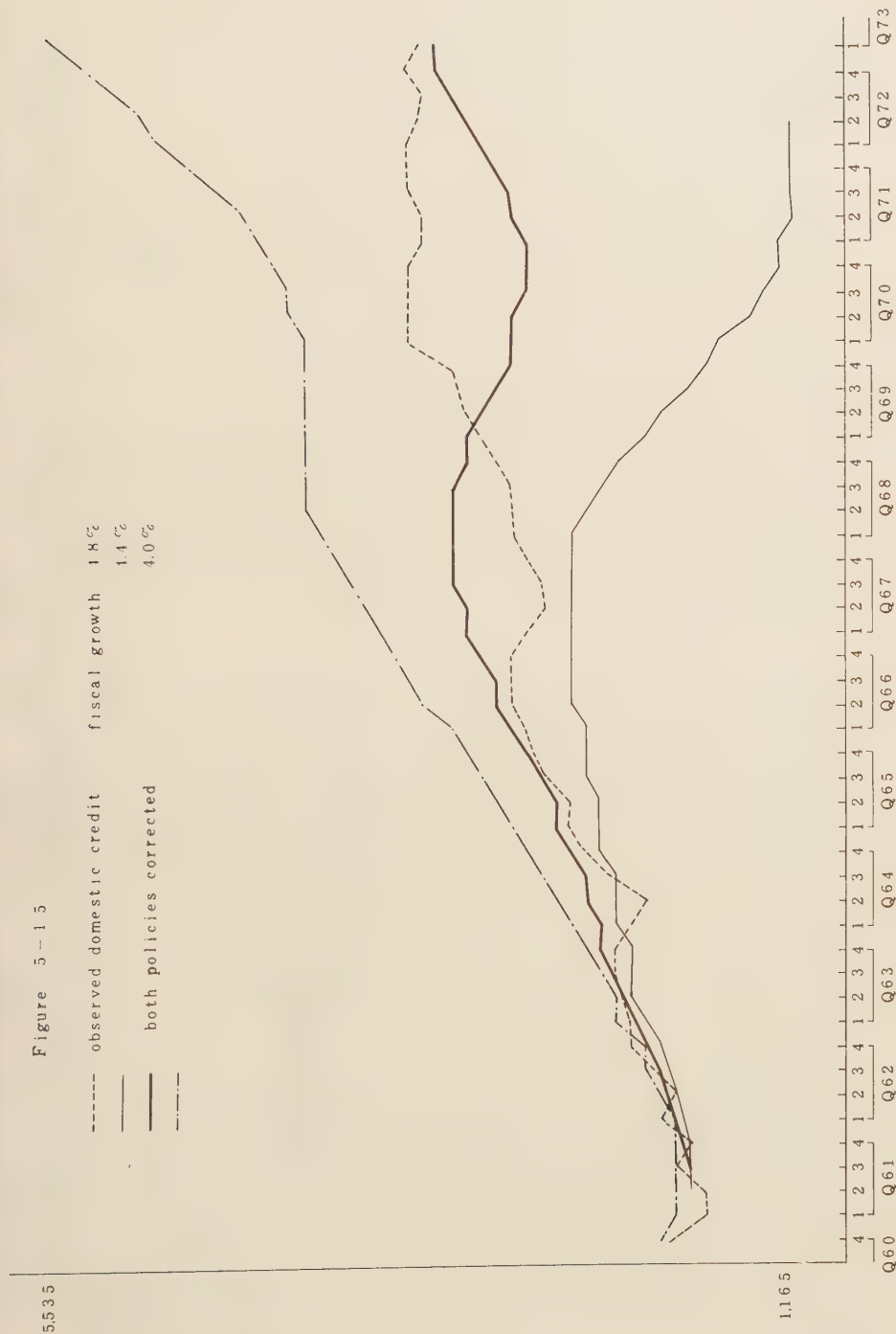
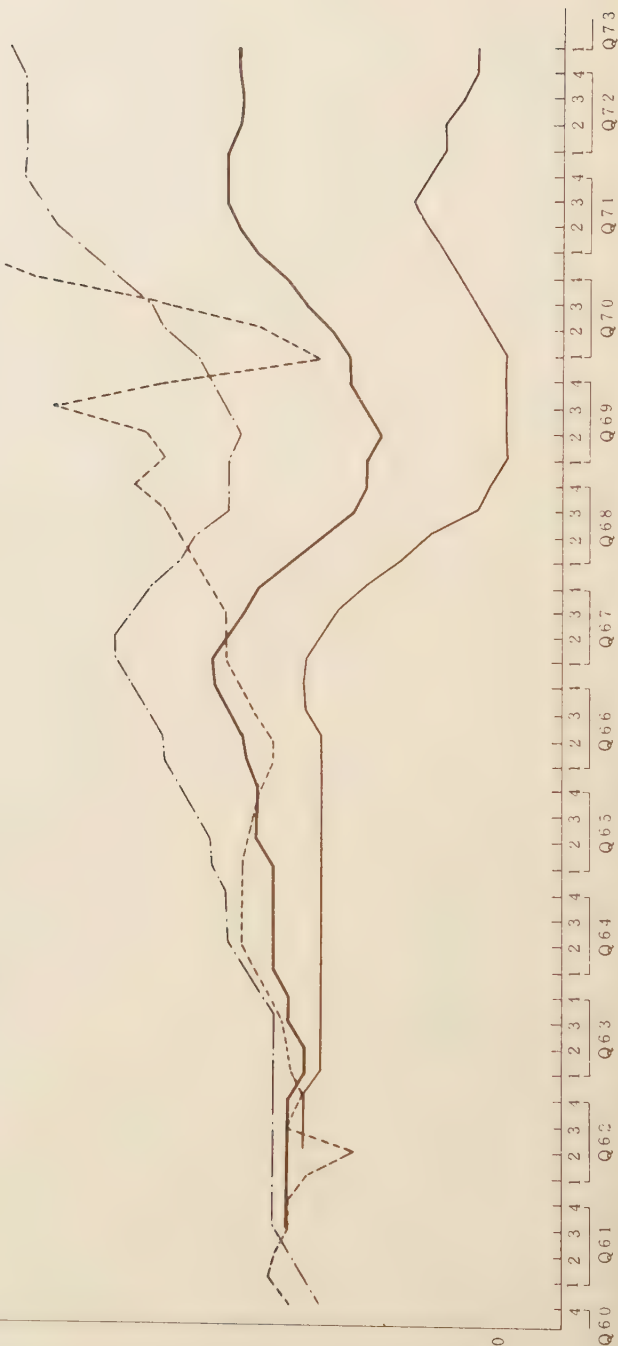


Figure 5-16

----- observed foreign reserves
 ----- fiscal growth 4.8%
 ----- 4.4%
 ----- both policies corrected 4.0%



APPENDICES

(1) Definition of variable

The model includes the estimation of differential equations of the type:

$$Dy = \beta y + \varepsilon \quad (1)$$

where β is the parameter, y is the explanatory variable, D the differential operator and ε the random term. Obviously, y and Dy are interrelated variables so that some restrictions should be imposed between them when an estimation of the equation is attempted. Actually, Dy is defined as

$$Dy = y_t - y_{t-1}$$

while y_t is defined as

$$\frac{1}{2}(y_t + y_{t-1}),$$

where y_t and y_{t-1} are the raw data. (It is assumed that y is observed at the end of the period.) Therefore the specification to be used in the actual estimation is

$$y_t - y_{t-1} = \frac{\beta}{2}(y_t + y_{t-1}) + \varepsilon$$

or

$$(1 - \frac{\beta}{2}) y_t - (1 + \frac{\beta}{2}) y_{t-1} = \epsilon \quad (2)$$

(2) Linearization

In order to log-linearize a relationship such as

$$DR = p + DX \quad (3)$$

around the steady state growth rate, denoted λ , write

$$R = e^{\log R}, \text{ etc.}$$

Expanding the right hand side in a Taylor series around λ we obtain

$$R = R^* e^{\lambda t} + R^* \lambda^t (\log R - \log R^* - \lambda t) \quad (4)$$

where R^* denotes the initial value. Assuming that R , p and X all grow at the same rate λ in the steady state, we may apply the same operation to p and X . Substituting (4) into the LHS of (3) and the corresponding expressions for p and X for RHS of (3), and imposing

$$\lambda R^* = p^* + \lambda X^*$$

as a restriction on the steady state, we obtain

$$\begin{aligned} D \log R = & -\lambda \log R + \frac{p^*}{R^*} \log p + \lambda \frac{X^*}{R^*} \log X + \frac{X^*}{R^*} D \log X + \\ & + \text{const.} \end{aligned} \quad (5)$$

(3) Data Source

Most of the data needed for estimation were collected

either from the International Financial Statistics (national income statistics, the stock of foreign reserves, the stock of domestic credit, and the wage rate) or from the Statistical Supplements of the Deutsche Bundesbank's Monthly Report (Statistische Beihefte, Monatsberichte der Deutschen Bundesbank). The level of foreign assets and liabilities (short-term) and the interest rate are taken from these sources. Since no published data on the GNP deflator are available, the price level is defined as a weighted average of the price of industrial goods and of consumer goods both of which are reported in the IFS. Following van der Werf,¹⁾ who estimates the share of consumer goods in total expenditure as 57%, 0.57 is used as the weight for consumer goods price and 0.43 for industrial wholesale prices.

With respect to the interest rate, the Frankfurt am Main money market rate (3-months) is used as the domestic interest rate. The Monthly Report of the Deutsche Bundesbank reports this interest rate on a monthly basis. A three-months average of this rate was calculated in order to make it correspond to the other data that are reported on a quarterly basis.

Although most of the econometric studies on capital flows in the Eurodollar market²⁾ make use of the Eurodollar rate for the "foreign" interest rate, it is not possible to follow this line in the present study, since we were concerned with the period 1960 - 1973 and the Eurodollar rate is not reported for the earlier periods. Instead of using this, the 3-month treasury bill rate of the New York money market rate, adjusted for the three months forward

1) Van der Werf, Dirk, "The Economy of the Federal Republic of Germany in Fifteen Equations", German Economic Review, 1972, No. 3., pp. 216 - 232.

2) See for instance Knight, Malcolm, "Eurodollars Capital Mobility and the Monetary Approach to the Balance of Payments", mimeo, 1974, and Porter, op. cit.

rate, is used for the foreign interest rate.

The data are quarterly, running from the first quarter 1960 till the fourth quarter 1973. With respect to the stock variables that are reported either at the end or at the beginning of a period, two-quarter moving averages are taken to convert them to mid-period figures. Moreover, since some of the behavioral relationships include changes from one quarter to another (DC, DFL, etc.), such variables are lagged once. Thus the final data set to be used in the estimation has 54 observations. In addition, the original data are deseasonalized, on the assumption that the policy authorities do not try to wipe out seasonal fluctuations.

(4) Alternative specifications

Although the estimated result reported in the text is the best of many attempts, it is somewhat puzzling that the target inflation rate was estimated to be negative. Mathematically speaking, the estimated instability has been caused mainly by the following observation.

As noted in Appendix (2) above, the balance of payments equation

$$DR = p(y - e - g) + DFL - DFA \quad (5-3)$$

is explained around the steady state growth rate of foreign reserves (note this as λ_4):

$$\begin{aligned} D \log R = & \frac{p^*(y^* - e^* - g^*)}{R^*} \log p + \frac{p^* y^*}{R^*} \log y - \\ & - \frac{p^* e^*}{R^*} \log e - \frac{p^* g^*}{R^*} \log g + \lambda_4 \frac{FL^*}{R^*} \log FL - \\ & - \lambda_4 \frac{FA^*}{R^*} \log FA + \frac{FL^*}{R^*} D \log FL - \frac{FA^*}{R^*} D \log FA - \\ & - \lambda_4 \log R \end{aligned} \quad (5-17)$$

Considering that the integral policy implied by the reaction of the authorities would, if the model is stable, equalize the steady state growth rate of the foreign reserves with the target foreign reserve growth rate, λ_4 is then equalized to λ_2 , the target reserve growth rate. The fact that λ_2 (or $\lambda_1 + \lambda_3$) has been estimated to be negative is mainly responsible (mathematically) for the estimated unstability of the model.

In order to avoid this problem, further attempts have been made. In particular, it is attempted to loglinearize the balance of payments equation around the mean value rather than the steady state growth rate of foreign reserves. Given the relationship

$$DR = p + DX \quad (3)$$

we have

$$\frac{DR}{R} = \frac{p}{R} + \frac{X}{R} \cdot \frac{DX}{X}$$

or

$$D \log R = \frac{p}{R} + \frac{X}{R} D \log X \quad (6)$$

$\frac{X}{R} D \log X$ is expanded around the sample means to give:

$$\frac{X}{R} D \log X = e^{\overline{\log X} - \overline{\log R}} D \log X + \overline{D \log X} e^{\overline{\log X} - \overline{\log R}} \left\{ 1 + (\log X - \overline{\log X}) - (\log R - \overline{\log R}) \right\} \quad (7)$$

where the barred variables stand for their respective mean values. Likewise, p/R is expanded around the sample means to give:

$$\begin{aligned} p/R &= e^{\overline{\log p} - \overline{\log R}} \left\{ 1 + (\log p - \overline{\log p}) - (\log R - \overline{\log R}) \right\} \\ &\quad - (\log R - \overline{\log R}) \end{aligned} \quad (8)$$

(7) and (8) are then substituted into (6) to give:

$$\begin{aligned} \text{Dlog } R = A_0 + A_1 \text{ Dlog } X + A_2 \log X + A_3 \log p + \\ + A_4 \log R \end{aligned} \quad (9)$$

where A_0 , A_1 , A_2 , A_3 and A_4 are the values calculated from $\overline{\log X}$, $\overline{\log R}$ and so on.

An attempt was made to estimate a model which had exactly the same structure of the model reported in the text, except that the balance of payments equation was specified as (9) above, rather than as specified in the text. Because the loglinearization around the mean value implied that the balance of payments equation to be estimated did not contain the steady state growth rate of foreign reserves, it was expected that the estimation might not cause the instability problem described in the text.

The change in the specification had little effect on most of the parameters to be estimated except the target inflation rate and capital flow equations. Although the target inflation rate was estimated to be positive, it was not significantly different from zero. The elasticity of capital flows with respect to monetary disequilibria was now estimated to be negative, and insignificantly different from zero. When a further attempt was made by restricting the target growth rate of real national income to be its sample mean (1.13% per quarter), the target inflation rate was estimated to be about 3.6% per year and this estimate was very significant. However, the elasticity of capital flows with respect to monetary disequilibria was again estimated to be negative. The result being hard to interpret, it was decided to maintain the results as reported in the text.

Chapter 6

CONCLUSION

This thesis has attempted to make use of a reaction function approach in analyzing the behavior of the policy authorities.

It will be useful to point out some of the limits of this study and then to suggest possible future works.

One of the shortcomings of the model, as indicated earlier, is that it is based on a Keynesian assumption as far as the labor market is concerned. Although this was necessary for the sake of simplicity, and although the invalidity of such an assumption may be to some extent discounted for a country like Germany that could import substantial foreign labor, such an assumption about the labor market might have been too strong. It will be worth replacing this particular assumption by the assumption of flexible wages and examining its consequences.

Related to this question is the treatment of expectations in the model. As we have seen, the model does not contain expectation variables. Such a treatment has prevented us from introducing an expectation--augmented Philips curve--type hypothesis in specifying the wage-price dynamics.

With respect to the specification of policy reaction functions, there are several points to notice. First, it would have been worth while to specify the reaction

functions as dependent on the inflation rate, growth rate of real income and the balance of payments, rather than, as we did, on the price level, income level and the level of foreign reserves (relative to respective target levels).

Secondly, further useful attempts might be made by incorporating policy measures not explicitly treated in the model. In particular, the reserve requirement policy, whose importance gradually increased towards the end of the sample period, may have to be incorporated by treating the private banking sector independently of the private nonbanking sector.

Apart from the particular specification of the model, some general comments on the use of the reaction function approach should be mentioned.

As far as the reaction function of the authorities is concerned, it is extremely desirable that we have a more solid theory that explains the behavior of the authorities by a number of reasonable assumptions. As explained in Chapter One, Theil's theory of the optimum decision rules for the government is based on some dubious assumptions which might limit the scope of the theory as a device to explain the authorities' behavior. What is of crucial importance in remodelling the authorities' behavior is the choice of variables which explain presumably the cost (welfare) function of the authorities. These variables should be limited to the class of variable that are related to economic performance alone.

The second point to notice is the scope of the use of our approach. Although this thesis used the reaction function approach in a small open economy framework, a more interesting application may be possible by extending the approach to a two-country framework. Such an extension may be applied to the dollar problem. In particular, the difference in the attitude of policy formation across countries (say, USA and Europe) as expressed in their respective reaction functions might explain the long-run development of the dollar problem as well as world

inflation. Such an empirical study could suggest ways in which monetary authorities in different countries can cooperate in order to improve their overall performance.

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